Job Stress in the Childhood Determinants of Adult Health Study: An Examination of Childhood Predictors and Associations with Adult Health Risk Behaviours

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Abstract

Background

Few studies have investigated the role of childhood factors in adult job stress or the association of job stress and multiple health behaviours in one cohort. The aims of this thesis were to: 1) examine whether a range of childhood factors were associated with adult job stress and 2) examine the association between job stress and health risk behaviours, including their co-occurrence.

Methods

Participants (aged 31-41 years) with completed effort-reward imbalance (ERI) scales (n=1,481) came from the Childhood Determinants of Adult Health study. This study began in 1985 with children aged 7 to 15 and had follow-up for 25 years (2009-11). Childhood measures included socioeconomic position (SEP), health- and school-related factors. Adulthood measures included the ERI scale and health risk behaviours (e.g., smoking, alcohol, physical activity, dietary behaviours, obesity and sitting time). Log binomial, log multinomial and linear regression with adjustment for potential confounders assessed: 1) the associations between childhood factors and adult job stress and 2) the associations between job stress and health risk behaviours (separately and together in a 'Healthy Lifestyle Score' to assess co-occurrence).

Results

Lower adulthood ERI and lower effort, indicating less job stress, were predicted in men by better learner self-concept and better academic attainment in childhood. Higher reward, indicating less job stress, was predicted in men by better academic attainment and enjoyment of physical activity. Greater adulthood ERI, indicating higher job stress, was predicted in men by worse self-rated fitness compared to peers, poorer self-rated health and doing less physical

activity in childhood and was predicted in women by being overweight, drinking alcohol, smoking and higher negative affect in childhood. Higher effort was predicted in men by worse self-rated fitness compared to peers, drinking alcohol and doing less physical activity and was predicted in women by being overweight, drinking alcohol and smoking in childhood. Higher reward was predicted in men by lower negative affect and doing more physical activity and was predicted in women by being overweight and less negative affect in childhood. Childhood SEP had inconsistent associations with adult ERI and its components. For analyses of the cross-sectional association between adult job stress and health risk behaviours, there were independent associations with both individual and co-occurring health risk behaviours. Higher ERI was associated with less often having a higher healthy lifestyle score, eating more serves of extra foods per day, doing less minutes of leisure time physical activity per week and spending more minutes of sitting at the weekend in men. In women, higher ERI was associated with doing less minutes of transport related physical activity, taking more steps per day, more often being a current smoker and consuming takeaway food twice a week or more. In terms of the components of the ERI scale, higher effort was associated with eating more serves of extra foods per day and spending more minutes of sitting at the weekend in men and was associated with doing more minutes of physical activity in the workplace, doing less minutes of transport-related physical activity, more often being a current smoker and consuming take away food twice a week or more in women. Higher reward was associated with meeting more dietary guidelines on the Dietary Guideline Index, eating less serves of extra food per day and spending less minutes of sitting time at the weekend in men.

Conclusion

Childhood factors including SEP, but also school- and health-related factors predicted adult ERI. Future studies of job stress and health should consider the effect of pre-employment factors including those from early in life. Job stress at work may lead to more unhealthy

behaviours, such as poor eating habits, smoking, excess sitting and a lack of exercise in either men or women.

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Abbreviations

AIHW	Australian Institute of Health and Welfare
ASHFS	Australian Schools Health and Fitness Survey
CDAH study	Childhood Determinants of Adult Health Study
CVD	cardiovascular disease
D-C model	Demand-Control model
DGI	dietary guideline index
ERI model	Effort-Reward Imbalance model
FPS	Finnish Public Sector
HILDA Survey	Household, Income and Labour Dynamics in Australia Survey
IPD-Work	Individual-Participant-Data Meta-Analysis of Working Population
LTPA	leisure time physical activity
PAR	population attributable risk
SEI	school engagement index
SEP	socioeconomic position
SWA	Safe Work Australia
WHO	World Health Organization
WHP	workplace health promotion

Statement of authorship

The data used in this thesis comes from the Childhood Determinants of Adult Health (CDAH) study, which is a large national cohort study of Australian adults. The data collection was complete when Shuo Wang joined the CDAH team and therefore she was not involved in the study design or the data collection. Shuo had sole responsibility for cleaning the data from the job stress instrument.

This thesis includes unpublished papers for which Shuo is not the sole author. Shuo took the lead in the research in that she designed the research question, cleaned and analysed the data and wrote the manuscript. However, she was assisted by the co-authors. The contributions of each author are detailed below.

The results reported in Chapter 3 and Chapter 4

Shuo Wang, Dr Seana Gall, Professor Alison Venn and Associate Professor Kristy Sanderson

The contribution of each author:

Shuo Wang cleaned the data, undertook all the data analysis and contributed to the interpretation of the data, composed the drafts of the manuscript and coordinated revision of the manuscripts.

Dr Seana Gall provided statistical support, data interpretation and revised the manuscript.

Professor Alison Venn provided data interpretation and revised the manuscript.

Associate Professor Kristy Sanderson designed the study particularly the selection of the job stress instrument, contributed to data analysis and interpretation and assisted with editing Chapter 3.

Signed by primary supervisor_____

Signed_____ **Date**____3/05/2016_____

Chapter 1 Background

1.1 The definition of job stress

Job stress is generally defined as "the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the worker" [1]. It is sometimes also referred to as job strain, occupational stress, work stress or work-related stress. With the development of global economic integration, the labour market has changed. For example, machines have replaced most of the manufacturing work, work pace is increasing, more women and older people are gradually entering the labour market, job competition has become ferocious and part-time jobs and flexible work arrangements have increased. These changes have caused job instability and job losses are becoming more prevalent, potentially resulting in a greater prevalence of job stress [2]. An awareness of job stress has been increasing in recent decades because it is a problem for employees as well as for employers. Workers suffering job stress for prolonged period are more likely to have unfavourable physical and mental health and be less productive at work [3]. Meanwhile, their organisations are less likely to be successful in a competitive market [4].

1.2 Models of job stress

There are two well-established theoretical models of job stress: the Demand-Control (D-C) model [5] and the Effort-Reward-Imbalance (ERI) model [6]. The D-C model, often called the job strain model, mainly focuses on the proximal work environment and conceptualises job stress as high demand and low task control [5]. In this model, job demand refers to the workload including time pressure and role conflict, while job control refers to the person's ability to control work tasks [5, 7]. The ERI model has been more recently developed (*Figure 1*). It is based on social exchange theory and suggests that workers expect the rewards they receive will

be equivalent to the value of the efforts they have invested. The ERI model conceptualises job stress as the negative trade-off between high effort and low reward. In this model, effort refers to workload including work environment demand and physical load, while reward refers to money, esteem and occupational status control including job security and job promotion. It gives an ERI ratio to present the level of job stress (e.g., the higher ratio the higher the job stress), and the subcomponents of ERI (effort and reward at work) are also confirmatory factors of job stress [8]. Both of these models consider the demands of work. The D-C model focuses more on the work itself, such as workload and worker's ability to control their task, but not questioning their feelings about stress experience [5]. In comparison with the D-C model, the ERI model encompasses more distant macro-economic labour market conditions (e.g. flexible employment types, job security, salary) and personal characteristics (e.g. coping ability), as well as more consideration of workers' response to unfavourable work environments [8]. It therefore might be more suitable for current labour market conditions that have more flexible employment and more interpersonal communication [8].

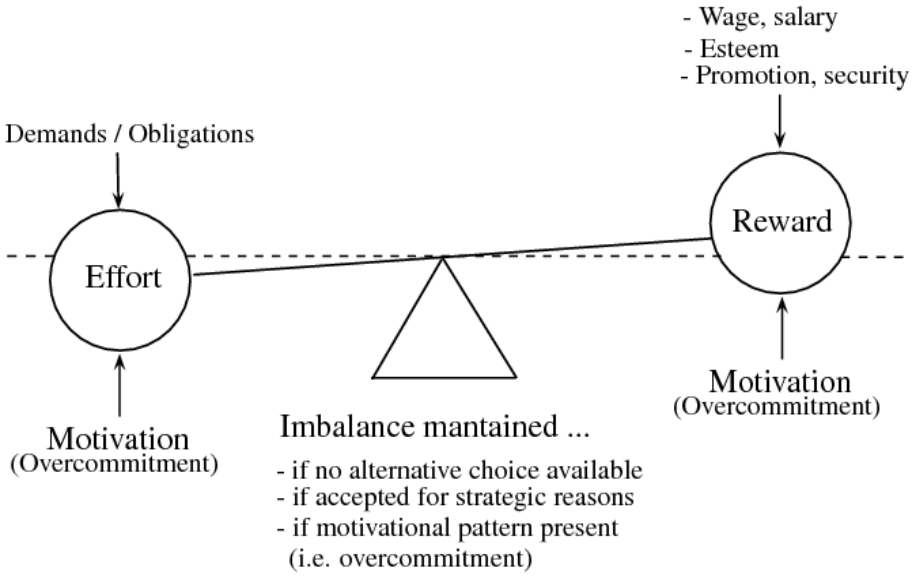


Figure 1 The effort-reward imbalance model [9]

1.3 The relationship between job stress and health

Previous reviews of prospective cohort studies have shown that job stress is a risk factor for common mental disorders [10], cardiovascular diseases (CVD) and all-cause mortality [11]. Others have also shown the association between job stress and health risk behaviours [12]. This section will summarise the literature on these relationships.

1.3.1 Job stress and physical health

The relationship between higher ERI (higher job stress) and the two subcomponents (high effort and low reward) of the ERI model, and higher incidence of CVD [13], cancer [14] and musculoskeletal disorders[15] has been shown. These diseases are associated with a high amount of disease burden in Australia and around the world. For example, CVD is one of the leading causes of death around the world and caused one third of global deaths in 2012, as well as in Australia [16, 17]. Furthermore, from the statistics of the Australian Institute of Health and Welfare (AIHW) in 2014, CVD, musculoskeletal disorders and cancer were the largest contributors to the burden of disease in Australia, accounting for 14%, 15% and 16% of it respectively [17].

It is therefore important to understand the nature of the relationship between job stress and these diseases, particularly if it is causal or mediated through other pathways. One potential mechanism for this relationship might be that job stress results in a physiological response and directly increases the risk of diseases. The most commonly cited physiological cause is the activation of the hypothalamus-pituitary-adrenal axis that results in changes in hormonal and neurobiological functions [18]. For example, higher job stress (measured by the ERI model) might elevate cholesterol levels, blood pressure and glucose [13] which may contribute to many chronic diseases such as stroke and type 2 diabetes [19], and the subcomponents of ERI model (high effort and low reward at work) are independently associated with high risk of

cardiovascular events [13]. High job stress also can increase the risk of musculoskeletal disorders by a chain of systemic physiological reaction of hyperventilation [15]. Simply put, high job stress might increase the respiration rate and minute ventilation, namely breathing that exceeds the metabolic requirements for oxygen (hyperventilation), and produce disruptions to the acid–base equilibrium, and then cause adverse implications for musculoskeletal health [15]. Although many researchers hold the view that job stress may contribute to the development of cancers, the direct association between job stress and cancers is still uncertain [14].

1.3.2 Job stress and mental health

Stress experienced in the workplace may lead to mental illness of workers, including the two most common mental disorders, depression and anxiety [20], by influencing autonomic nervous system and raising brain norepinephrine levels [21]. A systematic review by Bonde of 16 longitudinal studies indicated that work-related psychosocial stressors, such as high job demands, low decision latitude and effort-reward imbalance were associated with an elevated risk of depression [22]. A study by Jarman and colleagues based on the Tasmanian public sector workforce found that high ERI was associated with prevalence of high psychological distress [23]. Some researchers have also shown that positive mental health factors can prevent the detrimental effects of job stress on mental health. A longitudinal study by Page *et al.* based in 3,291 working adults in Brisbane indicated that positive mental health can protect or buffer the adverse effect of job stress on individuals [24].

The association between job stress and mental health is also important because mental health problems may have other effects on the health of employees and the economy. A study by Virtanen *et al.* based on the Finnish Public Sector Study identified that employees with psychological distress had 1.3 to 1.4 fold higher prevalence of long-term sickness absence than those without psychological distress [25]. Psychological distress may also be associated with

physical diseases. An individual meta-analysis by Russ *et al.* based on 10 large cohort studies in England found that psychological distress was associated with an increased risk of all causes mortality (20%), CVD deaths (29%) and death due to external causes (29%) in a dose-response manner, and higher level psychological distress was associated with deaths from cancer [26].

According to the World Health Organization (WHO), depression is one of the leading causes of diseases burden in high-income countries [27]. By the statistics, 14.7% Australian workforce had depression in 2007 [28]. Furthermore, approximately 1 in 9 Australians have mental disorders concurrently with physical diseases [17]. Therefore, the workplace health promotion programs that address reducing job stress also might be beneficial for employees' mental health and physical health.

1.3.3 Job stress and health risk behaviours

Important modifiable behavioural risk factors for physical diseases and mental disorders include physical inactivity, poor diet, smoking and excessive alcohol consumption [29]. These risk behaviours contribute to around 80% of heart disease, stroke and type 2 diabetes worldwide [17]. Job stress might indirectly effect health by exerting its influence on these risk behaviours and then elevate the incidence of physical and mental diseases [30, 31].

1.3.3.1 Individual risk factors

One of the largest studies of job stress and health is the "Individual-Participant-Data Meta-Analysis of Working Population" (IPD-Work) Consortium that pooled individual-level data from 17 European cohorts originally and stands at 26 studies including those from the United States and Australia currently [32]. A study pooled 11 IPD-Work Consortium European Studies and indicated that higher job stress was associated with an elevated risk of being a current smoker, a heavy alcohol consumer and performing less physical activity among the working

population with 1.14-fold, 1.02-fold and 1.15-fold odds respectively in the cross-sectional analyses [33]. For the longitudinal analyses, a study pooled 6 IPD-Work Consortium European longitudinal studies and revealed that high job stress predicted change from physically active to physically inactive during 2-9 years follow-up [34]. Additionally, Yang and colleagues based on 861 full-time employees of the ongoing Cardiovascular Risk in Young Finns Study found that leisure time physical activity in 1992 was associated with lower job stress over a 9 years follow-up [35]. The longitudinal association between job stress and some other health risk behaviours, such as smoking [36] or heavy drinking [37] was not clear in the IPD-Work Consortium. Another study, the SUCCESS project, which was conducted in 26 worksites of America also found that higher job stress was associated with a higher fat diet, less physical activity and being a smoker [29].

1.3.3.2 Co-occurrence of risk factors

Health risk behaviours tend to co-occur and the combined effect of health risk behaviours elevates the risk of poor health beyond single risk behaviours [38, 39]. The INTERHEART study by Yusuf *et al*. was a case-control study in 52 countries representing every inhabited continent. It suggested that the population attributable risk (PAR) of myocardial infarction for individual health risk behaviours was less than the combined risk behaviours, for example, smoking (36%), lack of fruit and vegetable consumption (14%), physical inactivity (12%) and alcohol consumption (7%) versus all risk behaviours (55%) [40]. In a 24-year follow-up study based in 77,782 US women, van Dam *et al*. indicated that the combined health risk behaviours including smoking, being overweight, physical inactivity, alcohol consumption and low diet quality score were associated with 51% PAR for all-cause mortality in younger women (aged <60 years). The PAR of individual health risk behaviours were from 7% to 28%, for example, smoking (28%), being overweight (14%), physical inactivity (17%), unhealthy diet (13%) and

heavy drinking (7%) [41]. The Finnish Public Sector (FPS) Study suggested that the association of job stress with co-occurrence of health risk behaviours is stronger than the associations with individual risk behaviours among workers aged 17 to 63 years [42, 43]. For example, after adjustment for age, socioeconomic position (SEP), type of job contract and marital status, the odds ratios (ORs) of association for comparison of 3-4 vs. 0 risk factors (OR=1.44 in women and OR=1.36 in men) was stronger than the associations for the comparison of 1 vs. 0 risk factors (OR=1.07 in women and OR=1.06 in men) and 2 vs. 0 risk factors (OR=1.25 in women and OR=1.22 in men) among men and women with high ERI (low ERI as reference group), and low effort and low reward were also associated with greater likelihood of health risk behaviours co-occurrence in either men or women [43]. The health risk behaviours included smoking, heavy drinking, physical inactivity and BMI$\geqslant$25 kg/m^2. However, these associations were inconsistent in the IPD-Work Consortium. The IPD-Work Consortium suggested that the association of job stress with co-occurrence of risk behaviours was similar to the associations of job stress with single behaviours according to longitudinal analyses results [33]. They did however find that individuals with higher job stress were 34% more likely to have co-occurrence of unhealthy behaviours than those with lower job stress using the D-C model at age 35 to 54 years in the cross-sectional analyses [33].

1.4 Economic impact of job stress

Besides unfavourable effects on health, another reason that job stress has gained attention is the associated economic losses. Previous reviews revealed that among the Australian working population, those workers with depressive and anxiety disorders were more likely to report absenteeism and presenteeism (attending work while sick), as well as lost productivity [44]. A report by the University of Melbourne and Victorian Health Promotion Foundation estimated that the depression that was attributable to job stress was costing $730 million per year in the Australian workforce[28]. In 2007, 1.54 million people in the Australian workforce had

experienced depression sometime in their life, with the total societal economic loss of this group being about more than $200 billion in their lifetime[28]. Recently, Safe Work Australia (SWA) estimated that job stress cost the Australian economy $14.81 billion a year. The loss caused by job stress included stress-related long-term absence, lost productivity at work and turnover [17, 45].

1.5 The risk factors of job stress

The origins of job stress are from both work-related and individual factors. Work-related factors include work content and context. The work content refers to the intrinsic nature of a job, for example, workload, working hours and task control. The work context refers to extrinsic factors, for example, career development, role in the organisation, interpersonal relationships, organisational culture and work-life conflict [46]. Individual characteristics such as coping styles are also important for predicting whether unfavourable work-related factors will lead to job stress [1]. These will be discussed in detail in this section.

1.5.1 Adult risk factors for job stress

Most research on job stress explores the consequences of job stress rather than its risk factors. As mentioned before, job stress comes from both intrinsic work content and extrinsic work context. The results of previous cross-sectional studies suggested that job stress, as indicated by both the D-C model and the ERI model, was associated with current personal (e.g. prior psychological diseases, education level) and work circumstances (e.g. contract types of employment, shift work and occupation status) [47-49]. For example, the negative associations between high job stress and lower education level or lower status occupations were found using both the D-C model and the ERI model [50, 51]. In the 1958 British Birth Cohort study, early adulthood psychological distress measured by the Malaise Inventory was associated with high job stress which was measured by the D-C model in adulthood [47]. More recent analyses in

the public sector in Australia, found an association between job stress using the ERI model and psychological distress measured by Kessler-10 [23]. Karhula and colleagues based on female nurses and nursing assistants of FPS found that working night shifts was associated with job stress (also measured by the D-C model) and sleep difficulties after work shifts [52].The study by Willis *et al.* based in police employees in Northern England found that shift work can enhance the association between ERI and work-family conflict [53]. Long working hours and irregular work schedule was also associated with high job stress as proved in a study of a British birth cohort [54]. Some researchers have looked at how employers perceive job stress. In an Australian study, it was found that individual factors (e.g., coping ability, personality, unhealthy before working), work context (e.g., pace of work, workload, workplace bullying), gender differences, work-home interface and sectoral and occupational differences were the risk factors for job stress as perceived by employers [55].

Additionally, besides stressors related to work content, other risk factors out of work are associated with job stress. For example, the imbalance between work and family life has an effect on individual job dissatisfaction. One study based in the Household, Income and Labour Dynamics in Australia (HILDA) Survey indicated that the combination of work related factors (e.g., job insecurity and others) and family-related factors (e.g., carers leave provided and flexibility to balance work and non-work commitment satisfaction) could explain 69.8% of the variance in overall job satisfaction which had a negative association with job stress [56]. Niedhammer and colleagues compared a large set of psychosocial work exposures between 31 European countries and found that significant differences in all psychosocial work factors between countries and gender difference existed [57]. The results of their study revealed gender differences, such that men were more likely to be exposed to long working hours, high effort, high ERI and work-family life imbalance while women were more likely to be exposed to low

job promotion. The prevalence of exposure to job insecurity and low reward were the same in both men and women [57].

Individual level factors such as adverse life events (e.g., divorce, illness financial difficulties and other stressful life experiences) [58] and personality [59] may also be associated with job stress. A random sample-based mail survey in Finland by Suominen and colleagues suggested that the co-occurrence between job stress and adverse life events was associated with sickness absence in women [60]. Even though an interaction between job stress and life events was not detected in their data, they still mentioned that life events should be considered in studies of the adverse effects of job stress [60]. Tornroos and colleagues based in Young Finns Study and found that personality might be associated with the risk of job stress and was differently associated with subcomponents of job stress. For example, high neuroticism and low agreeableness were associated with high effort, low reward and high ERI, while low extraversion was associated with low effort, low reward and high ERI[59].

This section summarised some of the individual and work-related factors that are associated with the risk of jobs stress. It is interesting that many of these are also associated with health risk behaviours and outcomes, such as SEP factors (e.g., education level and occupation status) [61] and personality [62]. They may therefore be confounders of the association between job stress and other outcomes. However, findings from IPD-Work Consortium of 11 European studies mentioned that some of these confounders (e.g., personality or adverse life events) had not been tested in analyses of job stress and health risk behaviours [33]. Exploring the association between job stress and health risk behaviours may provide new evidence to improve the health of the workforce including better evidence for workplace health promotion programs.

1.5.2 Pre-employment risk factors

The role of individual-level risk factors in adult job stress prompted questions about factors present before employment, so called pre-employment factors, that might contribute to the development of job stress. These distal risk factors might predispose an individual to interact with their environment in a certain way from as early as childhood and could play an important role for job stress [63, 64]. Investigating predictors of adult health and wellbeing from early in life is called life course epidemiology [65]. It suggests that the association between childhood risk factors and adulthood circumstance could be defined by diverse development procedures over time, including by factors such as SEP [66, 67].

In relation to job stress, higher parental SEP in childhood might have a beneficial effect on their offspring's education level and then contribute to lower job stress in adulthood. The association of higher parental SEP in childhood predicting lower job stress in adulthood was proven in the Young Finns study when using the D-C model [68], whereas the inconsistent association was found in the ERI model in the same cohort [63]. Hintsa and colleagues based in Young Finns Study and found that although parental SEP in childhood was associated with the individual effort and reward components in adulthood, there was no association between parental SEP and the total ERI scale in the study [63]. Except for parental SEP, other childhood factors such as area-level SEP [66] have not been investigated in the risk of job stress research. Additionally, early school experiences and adverse health behaviours in childhood might act as an important predictor of adulthood job stress. For example, negative school experience [69] may influence subsequent education and limit the possibilities of selecting occupation into adulthood.

Adverse health behaviours in childhood, such as smoking and alcohol consumption have an impact on lower adulthood SEP [64, 66], which might increase the risk in job stress [70].

Analyses conducted using data from the Young Finns study has shown that physical activity levels in childhood and adolescence might be protective against job stress in adulthood. Yang *et al.* found that sustained leisure time physical activity over 3 years in youth was associated with lower risk of job stress in early midlife [71].

The association between job stress and childhood factors, with the exception of SEP factors is quite limited. Improving the understanding of the risk factors of job stress in early life stage may provide new evidence for public and employers to pay attention to those individuals at risk and could lead to new ways to decrease job stress.

1.6 Interventions to address job stress in the workplace

For the reasons given above, interventions to prevent or manage job stress might have the potential to improve both physical and mental health, as well as to reduce losses and costs in workplace. The American Heart Association (AHA) also declared that workplace is an important setting for CVD promotion in a recent report [72]. More organisations are realising the benefits of a healthy workforce and are focusing on workplace health promotion.

One case study of such a program comes from Partnering Healthy @ Work (pH@W), which is a longitudinal evaluation of a comprehensive workplace health promotion and wellbeing program in all 15 Tasmanian State Service Agencies. The program conducted by the Tasmania Government and the University of Tasmania and involved a repeated, randomly selected cross-sectional health survey initiated by researchers, an anonymous online employer-initiated workforce health survey and human resource administrative data [23]. Evaluations revealed that 38% employees who participated in health and wellbeing activities (e.g., physical activity, health education) reported improvement in their health, such as improved work performance (20%), reduced stress (22%), weight loss (13%), healthier eating (19%), increased physical activity (34%), reduced alcohol intake (5%) and smoking cessation (3%) [73, 74].

As illustrated before, behavioural risk factors are important modifiable factors for physical diseases and mental disorders. WHO based in the European Network defined workplace health promotion as "the combined efforts of employers, employees and society to improve the health and well-being of people at work and focuses on those factors that may not be included in the legislation and practice of occupational health programmes, such as the promotion of healthy lifestyles" [75]. Although researchers considered that an effective job stress intervention program should include both individual-level and organisational-level [76], effective interventions to reduce job stress and improve health are still lacking [32]. Mostly, workplace health promotion programs improve workforce healthy lifestyles through health education. Whether reducing job stress might contribute to improvement of healthy lifestyles among employees is still uncertain.

In addition to there being a lack of evidence regarding what are effective workplace health promotion programs to improve employee health, there are barriers to getting employers to be interested in reducing job stress. A qualitative study by Page *et al.* examined the perceptions of job stress among a sample of employers in Australia [55]. They found that many employers thought that job stress was an individual-level problem that was not influenced by the workplace with a particular emphasis on it being a women's health issue. There was a lack of knowledge of how to prevent job stress in the workplace. As such, there is a need for more research to advance workplace health promotion approaches that address the adverse impact of stressful work environments on health. A better understanding of the causes and consequences of job stress could help with improving employee and employer understanding of this significant public health issue.

1.7 Aims of this research

The aims of this thesis were to explore the early life risk factors for job stress (study 1) and examine the association between job stress and health risk behaviours (study 2) (see *Figure 2*). It was hypothesised that positive school related factors, high SEP and better health in childhood would predict lower adult job stress and that high job stress would be associated with high prevalence of both co-occurring and individual health risk behaviours.

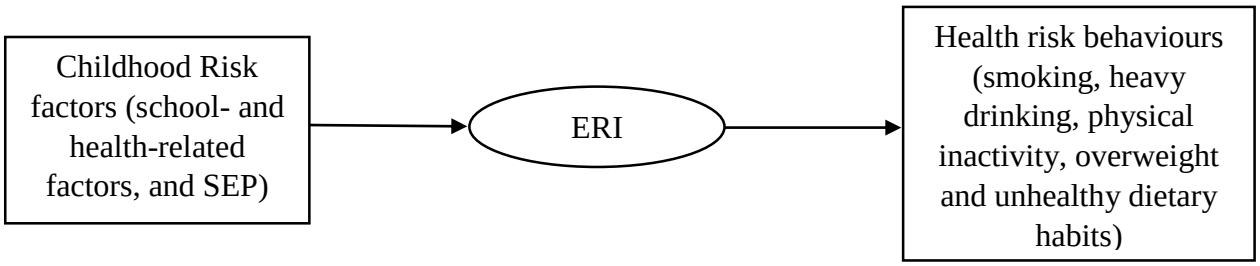


Figure 2 Conceptual model of this research

Chapter 2 Methods

2.1 Introduction

The data used to address the aims of this thesis came from the Childhood Determinants of Adult Health (CDAH) study. The CDAH study is a cohort study that has followed up the participants of the 1985 Australian Schools Health and Fitness Survey (ASHFS) twice in adulthood. The long-term aim of the CDAH study is to determine the contribution of childhood factors to the risk of developing CVD and type 2 diabetes in adulthood. This thesis examines data from a questionnaire-based follow-up study in 2009-11 that included measures of job and childhood measures gathered in 1985. This chapter describes the methods for this thesis including the protocols, participants and measurements used and brief description of the data analysis methods. Further details are provided in the individual results chapters (see Chapter 3 and Chapter 4).

2.2 Participants

There were 8,498 students that took part in 1985 ASHFS when they were aged 7-15 years. Briefly, the nationally representative sample of ASHFS schoolchildren was collected by two-stage probability sampling. At the first stage, 109 schools in six states and two territories were selected. Then, random sampling selected 10 boys and 10 girls from each age at each school. Children aged 9 to 15 years (n=6,559) completed the questionnaire on demographic, school-related and health-related factors, while all children aged 7 to 15 years had measures of body weight, height, girths and fitness measures. The details of sampling and data collection is described elsewhere [77].

During 2001-04, the CDAH study recontacted 5,170 participants who attended the 1985 ASHFS. Of these, 2,410 participants attended a study clinic and completed questionnaires at

ages 26-36 years in 2004-6 (CDAH-1). The details of sampling and data collection is described elsewhere [77]. In this wave of follow up, participants attended one of the 34 clinics conducted around Australia for physical measurements including blood sampling. They also completed questionnaires. Additional childhood SEP items were collected retrospectively during this follow up study.

During 2009-11, of those 2,410 participants who completed study clinics and questionnaires in the first wave follow-up, 1,890 participants completed the second wave of follow-up of the CDAH study at ages 31-41 years (CDAH-2). The ERI questionnaire was administered in this wave. After excluding those participants with incomplete ERI items and without a paid job, there were 1,481 participants included. The selection of participants is presented in Chapter 3 (see *Figure 3*) and Chapter 4 (see *Figure 7*).

2.3 Measurements

2.3.1 Childhood Factors

2.3.1.1 School related factors (collected in 1985 ASHFS)

School-related factors included a school engagement index (SEI), learner self-concept, academic attainment and enjoyment of physical activity. These items were assessed in a questionnaire in the 1985 ASHFS from children aged 9 to 15 years. As reported elsewhere, the SEI (range '*0*' to '*6*' with 6 meaning more engaged) combined items asking '*Do you enjoy school*?' and '*During the past few weeks how often have you felt bored*?' [78] Academic attainment was the scholastic level of each student assigned by a representative from the school and categorised into four groups ('*poor/below average*', '*average*', '*above average*' and '*excellent*'). Learner self-concept was measured from children's responses to the question: '*How good are you at school work compared to others of your age*?' with responses being

'*better than most*', '*about the middle*' or '*not as good as most*'. Children also reported whether they enjoyed school physical education (PE) or sports (response options: '*very much*' to '*don't do*') and physical activity in general (response options: '*yes*' or '*no*').

2.3.1.2 Health-related factors (collected in 1985 ASHFS)

Students' self-rated health and fitness, health risk behaviours and psychological well-being were assessed. The question on self-rated fitness asked students to compare their fitness with their peers (categories: *'better than most*', '*the same as others*' or '*worse than others*'). Self-rated health had 5 categories ranging from '*very good*' to '*very poor*'. Health risk behaviours in childhood included Body Mass Index (BMI), smoking status, alcohol consumption, physical activity and consumption of breakfast. BMI was calculated from measured height and weight and categorised into normal and overweight defined using age- and sex- specific cut-points [79]. Current smoking status was defined as either '*yes*' (≥1 cigarette/week) or '*no*' (non-smoking) and alcohol consumption as '*yes*' (any level of alcohol consumption) or '*no*' (non-drinking). The Bradburn Affect Balance Scale, which includes 10 questions, was used to assess psychological well-being [80]. The scale includes both an assessment of positive affect (5 items) and negative affect (5 items). Total minutes of physical activity was measured by self-report from children in the study and included riding and walking to or from school, in school or out of school sports and physical education in the past 7 days. As described in earlier publications from the CDAH study [81, 82], the total amount of time spent on physical activity was summarised and categorised into four different groups (categorises: *'<180 min/week', '180-360 min/week', '360-540 min/week'* or *'>540 min/week'*). Total minutes of in-school physical activity included the time spent on physical education and other school physical activity in the past 7 days. Total minutes of out-school physical activity included riding and walking to or from school and other out of school sports in the past 7 days.

2.3.1.3 Childhood SEP (collected in CDAH-1)

During 2004-6, participants were retrospectively asked some questions about their childhood SEP, when they were aged 12 years. These questions included highest education level (categories: *'less than 12 years', 'diploma/trade'* or *'equivalent/ higher than university degree'*) and occupation status (categories: *'manager/professional', 'clerical'* or *'labourer /no paid job'*) of their parents, how many rooms in their house (categories: *'less than 7', '8-10'* or *'more than 10 rooms'*), whether their parents owned the house in which they lived (response options: *'yes'* or *'no'*), how often they had moved (categories: *'0', '1-3'* or *'more than 3 times'*) and number of siblings (categories: *'0-1', '2-3'* or *'more than 3 siblings'*) [83, 84]. In addition, the area-level SEP was assigned using data from the Australia Bureau of Statistics' 1986 Census of Population and Housing using children's residential postcodes [69, 85].

2.3.2 Adulthood factors

2.3.2.1 Effort-Reward Imbalance (collected in CDAH-2)

Previous studies that assessed ERI used a proxy measure [43]. The validity of proxy ERI model has been shown, however, it lacks measurement of job promotion and salary satisfaction therefore underestimating job stress [86]. The current study used a standard measure of ERI, which included 17 items (6 effort items and 11 reward items): the effort scale covers workplace interruptions, job responsibility, pressure to work overtime and job demand, while the reward scale covers adequate support, being treated unfairly and adequate gains and reflects employee's response of esteem, job security and job promotion. Each item was given score ranging from 1 to 5. The sum score of effort ranged from 6 to 30 and reward ranged from 11 to 55. Higher effort in work and lower reward contribute to job stress. ERI ratio was calculated as effort/ (reward×6/11). In this study, the ERI ratio was used as a continuous variable, with

the higher score indicates higher job stress. The validity of the ERI model has been tested and verified [8].

2.3.2.2 Health risk behaviours (collected in CDAH-2)

Healthy Lifestyle Score

A Healthy Lifestyle Score was used to measure co-occurrence of health risk behaviours [19, 61]. The score comprised 10 healthy behaviours: BMI<25 kg/m^2, never smoker or ex-smoker≥12 months, ≥3 hours of moderate to vigorous leisure time physical activity(LTPA) per week, <20 grams of alcohol per day, fish consumption>3 times per week, consuming red meat <5 times per week, consumption ≥2 serves of fruit and ≥ 5 serves of vegetables per day (one item), regular use of skim milk, use of margarine instead of butter and not adding salt to food. The Healthy Lifestyle Score sums all items with the total score ranging from 0 (no healthy behaviour) to 10 (all healthy behaviours) [61]. This simple Healthy Lifestyle Score has previously been shown to be associated with cardiovascular risk profile (e.g., blood pressure, glucose) [19] and individual education [61] in the CDAH cohort, aligning with recommendations from peak health bodies such as the National Health and Medical Research Council in Australia [61].

Smoking status

Smoking status was measured by self-reported questionnaires on smoking history over a person's lifetime. The categories were '*never smoker*' (smoked less than 100 cigarettes over lifetime and had never been a current smoker), '*ex-smoker*' (smoked more than 100 cigarettes over lifetime, had been a daily smoker but was not currently smoking) or '*current smoker*' (smoked more than 100 cigarettes over lifetime and currently smoked on a weekly or daily basis).

Alcohol consumption

Two items were used to measure alcohol consumption: one was measured from participants' responses to the question: '*On a day, when you drink alcohol, how many standard drinks do you usually have?*' with responses being '*never drinking*', '*1 or 2 drinks per day*', '*3 or 4 drinks per day*' or '*more than 5 drinks per day*' and presented as a categorical variable. The other was estimated from the usual frequency of consumption of 10 common types of alcoholic beverages over the previous 12 months multiplied by the average alcohol concentration of each beverage, then summarised as daily alcohol consumption in grams and presented as a continuous variable [61].

Body Mass Index (BMI)

BMI was calculated from self-reported height and weight. A correction factor that based on data collected at the earlier follow-up gave estimates of clinic-measured BMI. The details of the calculations were described in a previous study [87]. The values of BMI were collapsed into *'normal'* (BMI <25 kg/m^2), *'overweight'* (25-29.9 kg/m^2) and *'obese'* ($\geq$ 30 kg/m^2).

Physical activity

The long version of the International Physical Activity Questionnaire (IPAQ-L) was used to assess levels of physical activity [88]. Participants self-reported duration and frequency of leisure time physical activity, domestic and gardening activities, work-related physical activity and transport-related physical activity. The total minutes of leisure time physical activity, work related physical activity, domestic and gardening physical activity and transport-related physical activity were calculated by multiplying frequency by duration, and then multiplied by the resting metabolic rate to get the MET-minutes/week respectively, calculation detail is described in Chapter 7.8. Participants reported how many hours and minutes they spent sitting

on a weekday and weekend day during the last 7 days. Variables of total sitting time in weekdays and weekend summarised as minutes as continuous variables.

Diet

The Dietary Guideline Index (DGI) was used for assessing participants' diet quality based on the Dietary Guidelines for Australian Adults [89] and the Australian Guide to Healthy Eating (AGHE) [90]. This index uses data from a 127-item food frequency questionnaire (FFQ) as well as a questionnaire on food habits. The DGI includes 15 components including whole-grain cereals, lean meat, reduced or low fat dairy and dietary variety. Each component scored 0-10, with 10 being optimal compliance. Proportional scores were given, when participants partially achieved a recommendation (e.g., adults are recommended to eat 2 serves of fruit per day, if someone consumed one piece of fruit/day, they would be assigned 5 points). The 15 components were summed to give the DGI score with a potential range of 0-150. A higher score indicates greater compliance with the Dietary Guidelines. This score has been shown to be a valid measure of diet quality and associated with cardio-metabolic risk factors in Australian adults [91].

Additionally, 'extra food' consumption and frequency of takeaway food consumption per week were measured. Extra foods include those which do not fit into the five core food groups (vegetables, fruits, cereals, meat and alternatives and dairy) and were summed by using conversion factors to give a daily equivalent for extra foods. Frequency of takeaway food consumption was measured from participants' response to the question, '*how many times per week would you usually eat hot takeaway meals*?' with responses ranging from '*I don't eat takeaway*' to '*6–7 meals per week*' and presented as dichotomous variable (*'less than twice per week'* or *'twice a week or more'*) [92].

Steps per day

Participants wore a Yamax Dighwalker SW-200 pedometer and recorded total daily steps, as well as daily start time and end time for seven consecutive days. The details of exclusion criteria and data management have been described elsewhere [81].

2.3.3 Potential covariates

Childhood age and all childhood SEP factors and adult age, SEP (participants' highest educational level and current occupational status), marital status, personality, adverse life events, depression and anxiety, social support, work schedule, working hours and type of employment contract (e.g., fixed-term contract, permanent contract) were considered as potential covariates, but only childhood age and SEP (area-level SEP and paternal occupational status) and adult age, SEP (participants' highest educational level and current occupational status) were considered as covariates when assessing the association between childhood factors and adult ERI (study 1). Adult age, SEP (highest educational level and current occupational status), working hours, work schedule, adverse life events and personality were considered as covariates when assessing the association between ERI and health risk behaviours (study 2). Full details are given in the respective chapters (see Chapter 3 and Chapter 4).

Adult SEP was estimated based on participants' educational level and occupational status wh ich were collected during 2009-10, at the same time point as ERI items collection, when parti cipants were aged 31-41. Participants' educational level was collapsed into three categories: *'less than 12 years'*, *'diploma/trade and equivalent'* or *'higher than university degree'*. The o ccupation status of participants was also collapsed into three categories: *'manager/profession al'*, *'clerical'* and *'labourer'*. Participants reported their current work schedule types, such as '*regular daytime schedule*', '*shift*', '*irregular schedule*' or '*on call*'. The number of adverse life events in recent five years, such as financial difficulties, separation and physical illness w ere self-reported by participants [93]. The personality of participants in this study was assess

ed by using data from the 60-item NEO Personality Inventory, which includes five dimensions: neuroticism, extroversion, agreeableness, openness and conscientiousness [94].

2.4 Data Analysis

Specific details for the analyses used in the different studies are described in detail in Chapter 3 for study 1 and Chapter 4 for study 2. In brief, log multinomial regression (for variables with three or more categories), log binomial regression (for variables with two categories) and linear regression (for continuous variables) with adjustment for potential confounders assessed: 1) the associations between childhood factors and adult job stress and 2) the associations between job stress and health risk behaviours. For continuous variables, the coefficient of regression (β) and 95% confidence intervals (CI) are reported. For categorical variables, risk ratios (RR) and 95% confidence intervals (CI) are reported. Logarithmic transformation was used to correct the kurtosis and skewness of the variables. The difference between men and women in baseline childhood factors and adult factors were examined by the Pearson Chi squared (X^2) test.

Multiple imputation with chained equations and with 30 estimations to impute missing data on covariates was conducted. For the multivariable model building, only potential factors that satisfied standard criteria for confounding factors (i.e., related to the exposures, the outcomes), and which caused a coefficient change ≥ 10% were included in models.

Previous studies implied a gender difference in job stress and that the components of the ERI scale independently predict disease [13]. Therefore, analyses were performed separately in male and females, and also for the different ERI components. All analyses were conducted with STATA version 12.1 (Statacorp, 2012).

2.5 Ethics

The 1985 ASHFS obtained approval from the Director General of Education in each state and territory and all participating children and their parents' consented. The CDAH follow-up study was approved by the Southern Tasmanian Health and Medical Human Research Ethics Committee and obtained all participants' written informed consent.

Chapter 3 Association between childhood health-, socioeconomic and school-related factors and effort-reward imbalance at work: a 25-year follow-up study

3.1 Introduction

Childhood and early adolescence are critical periods in personal development. It has been hypothesised that childhood experiences, including childhood SEP, could be important determinants for development of adulthood job stress [63, 64, 68, 95]. This is part of a broader literature examining the 'pre-employment' factors that might influence job stress.

In terms of childhood pre-employment factors for job stress, parental SEP is one of the most often examined. That high parental SEP in childhood should be directly and indirectly associated with lower job stress in adulthood was suggested in the Young Finns Study [68]. Hintsa and colleagues explored the association between parental SEP in childhood and adult job stress using different measures. One study tested job stress in the D-C model and the findings proposed that high parental SEP in childhood measured by parental educational level and household income are independent predictors of high control and low job strain in adulthood. High parental SEP in childhood also predicted higher education attainment in adulthood and was associated with higher control, higher demand and lower job strain [68]. An inconsistent association was found with the ERI model in the same cohort [63]. Hinsta and colleagues did a similar analysis also in the Young Finns study exploring the association between parental SEP in childhood and adult job stress in the ERI model. Although higher parental SEP in childhood was directly associated with higher reward in women and indirectly associated with higher effort via adult educational attainment in both genders, data revealed no association between parental SEP in childhood and total ERI [63].

Another Finnish study also found the same link between parental SEP and high adult job control and low job strain in offspring, strengthening the evidence that a true association exists,

when similar findings are replicated by different people in different contexts. Elovainio *et al.* conducted a study in a Northern Finland on a birth cohort and suggested that fathers having a higher SEP, as measured by the father's occupational status, was associated with higher job control and lower job strain in multivariable models including other pre-employment factors such as health behaviours and academic performance [64]. Apart from parental SEP, other childhood SEP factors such as area-level SEP [66] have not been investigated as risk factors for job stress despite an association being plausible. Individuals with low SEP in childhood may have less material and psychosocial resources leading to lower coping abilities, worse school performance and adverse physical and psychological health, which may again increase susceptibility and exposure to risk factors of job stress particularly through selection into occupations with greater job stress in adult life [96].

Besides childhood SEP, other childhood factors such as those related to school and health are also likely to play a role in the development of job stress in adult life [64]. School is where children acquire not only knowledge but also social skills [97] and it has some parallels with the workplace for adults. Children can practise their communication skills with their teachers and peers, which may be beneficial for their ability to cope in the work environment later in life [96]. Negative school experiences [69] may influence subsequent education and limit educational and occupational attainment into adulthood. Elovainio *et al.* [64] examined how some childhood school factors like academic performance, repeating class and absence from school might contribute to job control, job demand and overall job strain in early midlife. They found that a higher mean academic score was significantly associated with higher job control and job demands, but not job strain in multivariable models including covariates such as father's SEP. There were inconsistent associations with the other factors examined. Repeating a class was associated with lower job demands but not job control or job strain. Absence from class was not associated with any of the measures of job stress in adulthood [64]. Previously a

study of the CDAH cohort showed a positive longitudinal influence of better school engagement in childhood on higher adult SEP measured by educational level and occupational status [69], so it seems likely that it may also reduce risk of job stress. These findings support the notion that early school experiences might act as an important predictor of adulthood job stress.

Adverse health behaviours in childhood, such as smoking and alcohol consumption, are associated with lower adulthood SEP [64, 66], which might be associated with increased risk of job stress in adulthood [70]. A positive relationship between leisure time physical activity in adolescence and lower job strain in adulthood was found in the Young Finns Study. Yang *et al.* looked at 664 participants in a 27-year follow-up study and suggested that being physically inactive in leisure time in adolescence was an independent risk factor for higher job strain in adulthood compared to those people who in their adolescence had persistent physical activity over 3 years, with 2.14- and 5.21-fold odds in men and women, respectively [71]. The study by Elovainio *et al.* also examined alcohol consumption and smoking in adolescence as predictors of adult job control, job demand and job strain, but these were not associated with job stress in their study [64]. Additionally, lower psychological wellbeing in childhood may also make it more likely that people are exposed to unfavourable working conditions in adult life by impacting school performance resulting in low educational level and thereby a high risk of being unskilled labour in a working environment with a high accumulation of risk factors for job stress. For example, Stansfeld *et al.* looked at 8,243 employees aged 45 years in a British birth cohort and found that participants with psychological problems in childhood were 20% less likely to report higher demands and 51% more likely to report low decision latitude than those without psychological problems [47]. However, there seemed to be no association between childhood psychological problems and job strain. Furthermore, they found that distress in childhood was associated with a 1.5- to 2.7-fold increased odds of having lower

status job, namely manual occupations [47]. As with other pre-employment factors, the pathway from childhood physical and psychological health to adulthood job stress may be through adult SEP, however, more research is needed into this possible link to establish the influence of adult SEP as an intermediate factor between childhood health and adulthood job stress [35, 47, 64].

Although previous studies showed that some of the association between job stress and both mental and physical health can be accounted for inequality in SEP in those with adverse childhood experiences [47, 98], few studies have explored the association between other childhood factors and job stress. Furthermore, previous studies that used the ERI model were more likely to use a proxy measure with limited items rather than the full validated instrument. The validity of the proxy ERI model compared to the full model has been contested, as it lacks measurement of job promotion and salary satisfaction and therefore might underestimate job stress [99].

The aim of this study was to examine whether childhood SEP, school- and health-related factors were associated with adult ERI. First, the direct association between school-related factors, childhood SEP and health-related factors and ERI was explored. Second, whether adulthood SEP (education level and occupation status) was on the causal pathway between childhood factors and adult ERI was tested. There were two hypotheses of this study: i) better SEP, school- and health-related factors in childhood were associated with lower ERI in adulthood; ii) the association between childhood factors and adult ERI was mediated by adult SEP.

3.2 Method

3.2.1 Participants

This study includes those children, who had data on childhood school- and health-related factors back in the 1985 ASHFS, retrospective childhood SEP and ERI components. Among those people who completed ERI items (n=1,481), 999 participants completed all of the 1985 questionnaire with school- and health-related factors, 1,108 participants completed the CDAH-1 questionnaire with retrospective childhood SEP and 1,390 participants had data on childhood BMI and academic attainment. The flow chart of participants for inclusion in this study is shown in *Figure 3*.

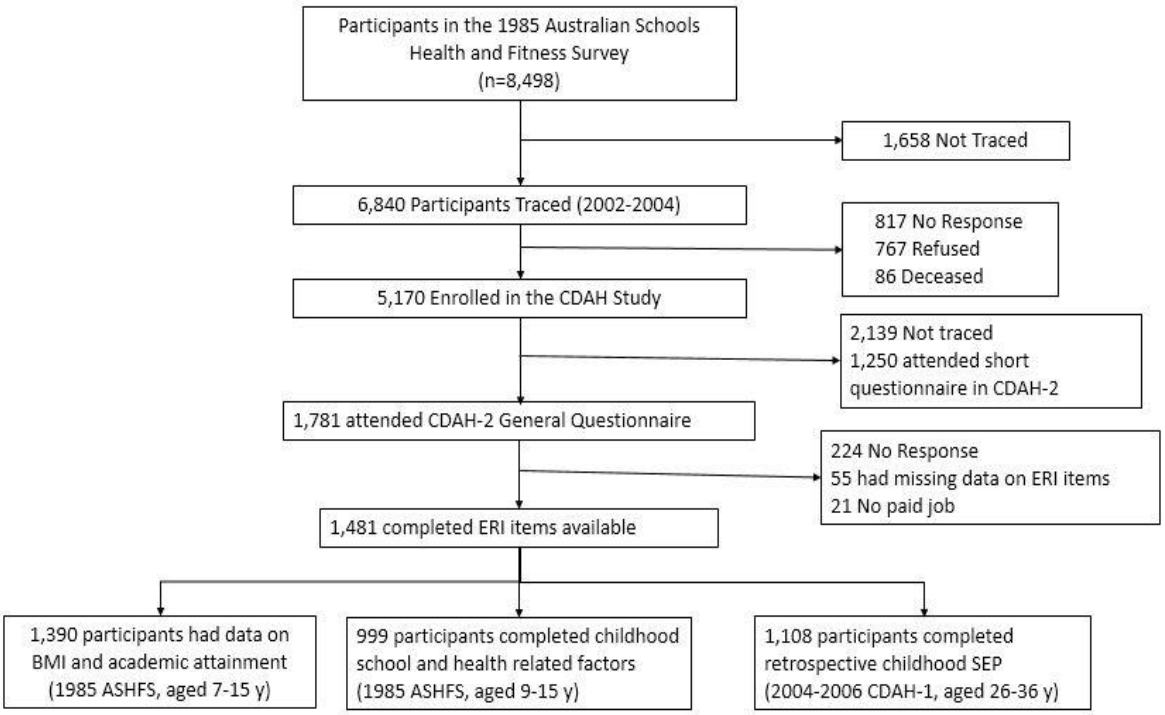


Figure 3 Selection of participants for Study 1

3.2.2 Measurements

Outcome

The outcome of this study was the ERI scale. This measure was described in detail in Chapter 2 and its distribution (mean, SD) in the CDAH study is shown below. For the analyses, the overall scale and the individual effort and reward scales were examined.

Exposures

Childhood factors in this study included school-related factors, health-related factors and SEP factors. School-related factors included school engagement index (SEI), learner self-concept, academic attainment, enjoyment of school PE/sports and enjoyment of physical activity. Childhood SEP factors included maternal/paternal education levels, maternal/paternal occupation status, rooms in home, housed rental, move frequency, number of siblings and area socioeconomic status. Health-related factors included self-rated fitness/health, BMI, alcohol consumption, smoking, eating breakfast, positive/negative affect, total minutes of physical activity, total minutes of in-school physical activity and total minutes of out-school physical activity. These measures were described in detail in Chapter 2.

Covariates

A wide range of potential covariates were considered (see Chapter 2), but only childhood age, childhood SEP (area-level SEP and paternal occupational status) and adult SEP (participants' highest educational level and current occupational status) included in models based on purposeful model building. The associations between adult SEP and ERI, as well as the effort and reward scales separately are provided in the appendix of this chapter. The details of these measures were described in Chapter 2.

3.2.3 Data analysis

Logarithmic transformation was used to correct the kurtosis and skewness of the total ERI ratio. A benefit of the log transformation of the ERI ratio is that the beta coefficients from the linear

regression models can be interpreted as the percentage difference in ERI ratio for a given exposure category compared to the reference category. The following variables were used in the imputation model: childhood age, school academic attainment, BMI and adult education level and self-rated health from an earlier adult follow-up. For the multivariable model building, it was intended to only include SEP markers that satisfied standard criteria for confounding factors (i.e., related to the childhood factors, the ERI components), and which caused a coefficient change ≥ 10%. However, for some analyses no SEP marker met these criteria, so father's occupation level and area-level SEP were selected for inclusion in the models, as they met these criteria most often. In the childhood SEP model, only age and adult SEP were adjusted in the analysis. Linear regression models of the association between childhood total minutes of in-school physical activity and total minutes of out-school physical activity, the adult ERI and its components presented in appendix. The additional analysis of the influence of adult health risk factors on associations between childhood health risk factors, the adult ERI and its components were examined in those childhood health-related factors that were significantly associated with adult ERI and with additional adjustment for the same risk behaviour in adulthood (see appendix).

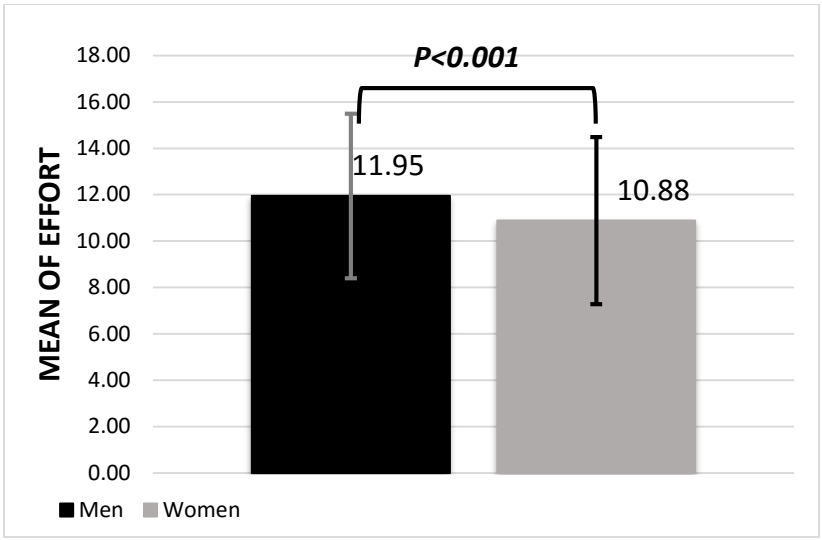
3.3 Results

The characteristics of included participants are presented in *Table 1*. There was no difference in mean age between men and women. Compared to men, women had a higher SEI score (women 6.9% vs. men 2.1%), higher adult educational level (university/higher) (women 51.2% vs. men 42.8%) and more often had clerical jobs (women 31.8% vs. men 6.3%). However, men had better learner self-concept in childhood (men 36.8% vs. women 29.2%) and managerial/professional occupation status (men 68.1% vs. women 61.4%) than women (Table *1*). The distribution of total ERI ratio, effort and reward scales for men and women are shown in *Figure 4*. Figures show that with regards to the outcome, women had lower mean [SD] effort

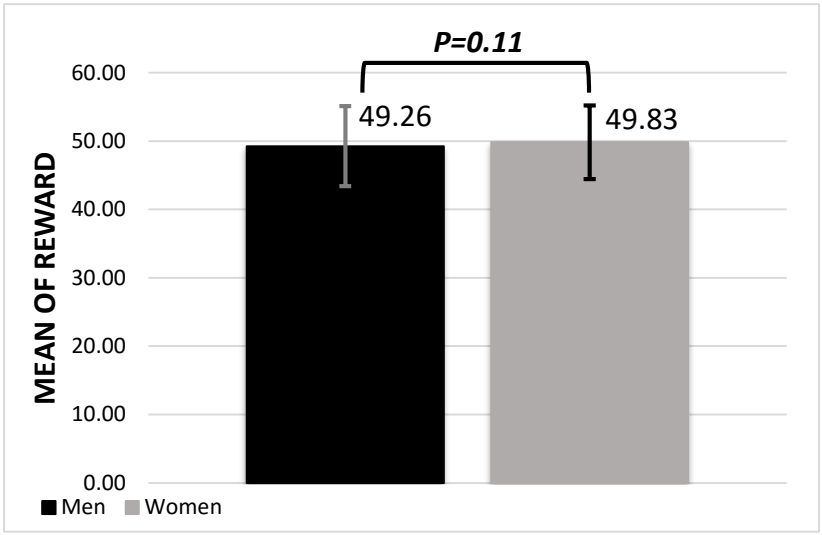
score (women 10.9 [3.6] vs. men 12.0[3.6]) and lower mean [SD] ERI ratio (women 0.41 [0.2] vs. men 0.46 [0.2]) than men, but there was no difference between the mean [SD] reward score in women and men (women 49.3 [5.8] vs. men 49.8 [5.4]).

Table 1 Characteristics of participants in childhood (1985) and adulthood (2009–2010)

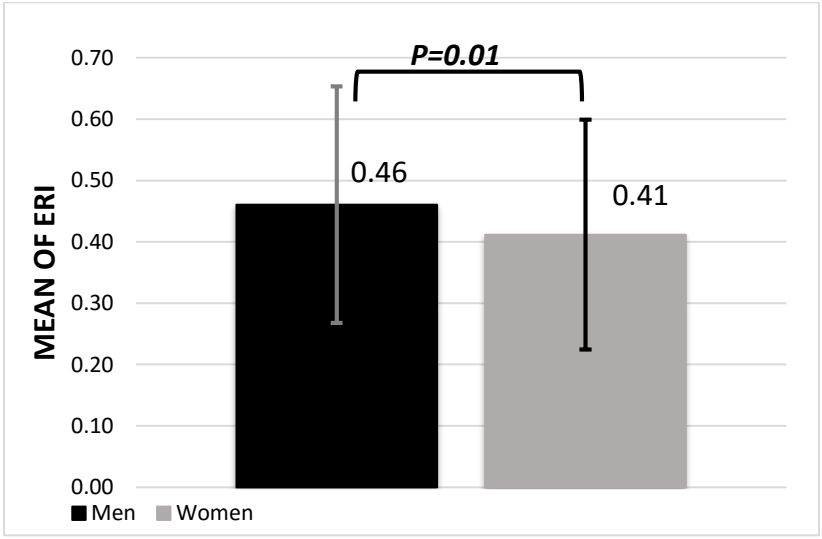
Variable	Men		Women		P-value
	n	%	n	%	
Age (years), Mean (SD)	37.5	2.1	37	2.0	0.41
School engagement index					
0	8	1.7	7	1.1	<0.01
1	18	3.7	12	1.9	
2	60	12.5	71	11.0	
3	148	30.8	177	27.3	
4	154	32.0	224	34.6	
5	83	17.3	112	17.3	
6	10	2.1	45	6.9	
Learner self-concept					
Worse than others	35	7.3	35	5.4	0.01
Same as others	269	55.9	424	65.4	
Better than others	177	36.8	189	29.2	
Area-level SEP					
Low	35	7.3	41	6.3	0.91
Mid-low	183	38.1	256	39.5	
Mid-high	135	28.1	182	28.1	
High	128	26.6	169	26.1	
Self-rated fitness					
Better than others	140	29.1	127	19.6	<0.001
Same as others	307	63.8	449	69.3	
Worse than others	34	7.1	72	11.1	
Participants' education level					
≤12 years	91	18.9	145	22.5	<0.001
Trade/certificate	184	38.3	170	26.3	
University/Higher	206	42.8	331	51.2	
Participants' occupation status					
Labourer	123	25.6	44	6.8	<0.001
Clerical	30	6.3	205	31.8	
Manager/professional	327	68.1	396	61.4	



(a)



(b)



(c)

Figure 4 Distribution (mean, SD) of effort (a), reward (b) and ERI ratio (c) for men and women

The childhood characteristics of the participants with complete childhood school- and health-related factors and SEP measures as well as adult ERI items were compared to those without these data to examine the representativeness of the sample (*Table 2*). For the childhood sample, the participants and non-participants were similar with regard to mean [SD] childhood age (participants 11.2 [2.5] vs. non-participants 11.0 [2.6]), the proportion that lived in a higher area-level SEP (participants 26% vs. non-participants 23%) and the proportion that rated their fitness as better than others (participants 24% vs non-participants 20%). The proportion of female (participants 57% vs. non-participants 47%) and the proportion of better learner self-concept (participants 32% vs. non-participants 22%) were greater in those followed up than those not followed up. The proportion of overweight (participants 9% vs. non-participants 12%), the proportion of smoking in childhood (participants 9% vs. non-participants 15%) were lower in those followed up than those not followed up. The proportion of drinking in childhood (participants 32% vs. non-participants 33%) was similar in those followed up and those not followed up. For the adult sample, participants at follow-up more often had higher education level (≥12 years) (participants 93% vs. general working population 75%) and higher occupation status (participants 66% vs. general working population 41%) than people in the similar age in the general working population (*Table 3*). Despite the loss-to-follow-up in adulthood, those remaining in the CDAH study are similar to the original study cohort in terms of childhood factors, but differ in terms of education level and occupation status in adulthood.

Table 2 Comparison of participants and non-participants in the CDAH study in childhood factors

	Participants		Non-participants		P
Variable	n	%	n	%	
Sex	1,481		7,017		<0.001
Male	618	41.73	3,689	52.57	
Female	863	58.27	3,328	47.43	
Childhood factors					
Age, mean(SD)	1,481	11.2(2.5)	7,017	10.8(2.6)	0.002
Area socioeconomic status	1,162		5,137		0.002
Low	78	6.71	504	9.81	
Mid-low	454	39.07	1,973	38.41	
Mid-high	323	27.8	1,477	28.75	
High	307	26.42	1,183	23.03	
Academic attainment	1,391		6,570		<0.001
Poor	18	1.29	374	5.69	
Below average	131	9.42	1,205	18.34	
Average	543	39.04	2,736	41.64	
Above average	492	35.37	1,719	26.16	
Excellent	207	14.88	536	8.16	
SEI	1,177		5,150		<0.001
0	15	1.27	120	2.33	
1	30	2.55	270	5.24	
2	138	11.72	707	13.73	
3	345	29.31	1,551	30.12	
4	391	33.22	1,487	28.87	
5	203	17.25	798	15.5	
6	55	4.67	217	4.21	
Learner self-concept	1,184		5,214		<0.001
Worse than others	75	6.33	553	10.61	
Same as others	728	61.49	3,509	67.3	
Better than others	381	32.18	1,152	22.09	
BMI	1,480		7,012		<0.001
Normal	1,353	91.42	6,139	87.55	
Overweight	127	8.58	873	12.45	
Smoking	1,178		5,192		<0.001
No	1,071	90.92	4,421	85.15	
Yes	107	9.08	771	14.85	
Alcohol consumption	1,184		5,213		0.456
No	806	68.07	3,490	66.95	
Yes	378	31.93	1,723	33.05	
Negative affect, mean(SD)	1,162	6.1(1.7)	5,050	6.1(1.7)	0.241
Positive affect, mean(SD)	1,164	3.6(2.0)	5,052	3.8(2.0)	0.364

Table 3 Comparison of participants and general working population in Australia in SEP factors

	Participants		General working population*	
Variable	n	%	N ('000)	%
Education level	1,784		2128.6	
Low (8-9 years)	15	0.84	59.0	2.77
Middle (10-11 years)	111	6.22	482.2	22.65
High (≥ 12 years)	1,658	92.94	1587.4	74.58
Occupation status	1,526		2131.2	
Low(Labourer)	216	14.15	609.4	28.60
Middle (Clerical)	303	19.86	643.2	30.18
High (Manager)	1,007	65.99	878.6	41.23

*Data of the general working population came from the 2011 Census of Australian Bureau of Statistics

School-related factors

Table 4 and *Table 5* show the association between school-related factors and ERI for men and women separately. Better learner self-concept and better academic attainment in childhood predicted lower ERI for men. These associations were not changed by adjustment for childhood or adult-hood SEP. For women, those with better learner self-concept had higher ERI compared to those that reported worse learner self-concept. The magnitude of the association was greatly reduced and was no longer statistically significant once adult SEP was included into the model.

Better learner self-concept and better academic attainment in childhood independently predicted lower effort for men (*Table 6*). For women, better learner self-concept predicted increased effort, but this association was no longer statistically significant after adjusting for adult SEP (*Table 7*).

In the reward scale, better academic attainment and enjoyment of physical activity were independently associated with higher reward for men (*Table 8*). For women, increasing SEI predicted higher reward for women and adult SEP slightly weakens this association (*Table 9*).

Table 4 Association between school-related factors and log ERI for men

Variable	Unadjusted		Model 1		Model 2		Model 3	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
SEI	-2	(-5, 1)	-2	(-5, 1)	-2	(-4, 1)	-2	(-4, 1)
Learner self-concept								
Worse than others	ref.		ref.		ref.		ref.	
Same as others	-11	(-23, 1)	-11	(-23, 1)	-12	(-24, 1)	-12	(-24, 1)
Better than others	**-19**	**(-31, -6)**	**-19**	**(-31, -6)**	**-19**	**(-31, -6)**	**-19**	**(-32, -6)**
Academic Attainment								
Poor/below average	ref.		ref.		ref.		ref.	
Average	**-9**	**(-18,-0.1)**	**-9**	**(-18,-0.1)**	**-10**	**(-18, -1)**	**-10**	**(-19,-1)**
Above average	**-12**	**(-21, -2)**	**-12**	**(-21, -2)**	**-12**	**(-21, -2)**	**-12**	**(-22,-2)**
Excellent	**-14**	**(-26, -2)**	**-14**	**(-26, -2)**	**-15**	**(-27, -2)**	**-15**	**(-28,-3)**
Enjoyment of school PE								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	9	(-11, 30)	9	(-11, 30)	10	(-10,31)	11	(-10,31)
Sometimes	9	(-5, 24)	9	(-6, 24)	8	(-6, 23)	8	(-6, 23)
Quite a lot/very much	5	(-8, 19)	5	(-8, 19)	5	(-8, 19)	5	(-8, 19)
Enjoyment of school sports								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-10	(-31, 12)	-9	(-31, 12)	-9	(-31,13)	-10	(-32,13)
Enjoyment of physical activity								
No	ref.		ref.		ref.		ref.	
Yes	3	(-12, 19)	3	(-13, 18)	2	(-14,18)	2	(-13,18)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$;

Table 5 Association between school-related factors and log ERI for women

Variable	Unadjusted		Model 1		Model 2		Model 3	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
SEI	-1	(-4, 1)	-1	(-4, 1)	-1	(-4, 1)	-2	(-4,<0.1)
Learner self-concept								
Worse than others	ref.		ref.		ref.		ref.	
Same as others	**15**	**(3, 28)**	**15**	**(3, 28)**	**15**	**(2, 27)**	11	(-2, 23)
Better than others	**13**	**(0.5, 26)**	**14**	**(1, 27)**	13	(-0.1,26)	7	(-6, 20)
Academic Attainment								
Poor/below average	ref.		ref.		ref.		ref.	
Average	5	(-6, 15)	5	(-6, 15)	4	(-6, 15)	1	(-9, 11)
Above average	2	(-8, 13)	2	(-8, 13)	2	(-8, 12)	-3	(-13, 7)
Excellent	1	(-10,12)	1	(-10,12)	1	(-10,12)	-4	(-15, 7)
Enjoyment of school PE								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-5	(-24,15)	-4	(-23,16)	-4	(-23,15)	-4	(-23,14)
Sometimes	2	(-11,15)	3	(-10,16)	1	(-12,14)	1	(-12,14)
Quite a lot/very much	1	(-11,13)	2	(-10,15)	0.2	(-12,13)	-1	(-13,11)
Enjoyment of school sports								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	6	(-13,24)	6	(-12,25)	5	(-14,24)	8	(-10,26)
Sometimes	-2	(-14,11)	-2	(-14,11)	-3	(-15,10)	-3	(-15, 9)
Quite a lot/very much	-2	(-13,10)	-1	(-13,10)	-3	(-14, 9)	-3	(-14, 8)
Enjoyment of physical activity								
No	ref.		ref.		ref.		ref.	
Yes	12	(-5, 30)	12	(-5, 30)	11	(-7, 29)	6	(-12,23)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05

Table 6 Association between childhood school-related factors and effort for men

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Men								
SEI (per unit)	-0.15	(-0.42,0.12)	-0.14	(-0.41,0.13)	-0.13	(-0.40,0.14)	-0.14	(-0.42,0.14)
Learner self-concept								
Worse than others	ref.		ref.		ref.		ref.	
Same as others	**-1.26**	**(-2.46,-0.06)**	**-1.23**	**(-2.43,-0.03)**	**-1.29**	**(-2.49,-0.08)**	**-1.34**	**(-2.55,-0.12)**
Better than others	**-1.93**	**(-3.16,-0.69)**	**-1.91**	**(-3.15,-0.68)**	**-1.93**	**(-3.17,-0.69)**	**-2.05**	**(-3.32,-0.78)**
Academic Attainment								
Poor/below average	ref.		ref.		ref.		ref.	
Average	-0.72	(-1.60, 0.17)	-0.71	(-1.60, 0.17)	-0.76	(-1.65,0.14)	-0.77	(-1.67, 0.14)
Above average	**-1.12**	**(-2.06,-0.19)**	**-1.12**	**(-2.06,-0.18)**	**-1.10**	**(-2.06,-0.15)**	**-1.18**	**(-2.17,-0.20)**
Excellent	**-1.46**	**(-2.66,-0.26)**	**-1.46**	**(-2.66,-0.26)**	**-1.45**	**(-2.67,-0.23)**	**-1.55**	**(-2.81,-0.30)**
Enjoyment of school PE								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	0.29	(-1.70,2.27)	0.27	(-1.72,2.26)	0.36	(-1.64,2.35)	0.34	(-1.67,2.35)
Sometimes	0.74	(-0.70,2.17)	0.72	(-0.72,2.15)	0.60	(-0.84,2.04)	0.61	(-0.84,2.06)
Quite a lot/very much	0.47	(-0.86,1.80)	0.46	(-0.87,1.79)	0.47	(-0.86,1.80)	0.47	(-0.86,1.81)
Enjoyment of school sports								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-1.60	(-3.76,0.56)	-1.59	(-3.75,0.56)	-1.46	(-3.62,0.71)	-1.45	(-3.64,0.74)
Sometimes	-0.46	(-1.95,1.02)	-0.46	(-1.94,1.02)	-0.45	(-1.93,1.04)	-0.46	(-1.97,1.05)
Quite a lot/very much	-0.68	(-1.98,0.61)	-0.73	(-2.03,0.57)	-0.65	(-1.95,0.65)	-0.66	(-1.99,0.66)
Enjoyment of physical activity								
No	ref.		ref.		ref.		ref.	
Yes	1.43	(-0.09, 2.96)	1.41	(-0.11,2.94)	0.96	(-0.68,2.59)	1.34	(-0.21,2.88)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$.

Table 7 Association between childhood school-related factors and effort for women

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
SEI (per unit)	-0.10	(-0.33,0.14)	-0.09	(-0.33,0.15)	-0.11	(-0.34,0.13)	-0.17	(-0.40,0.06)
Learner self-concept								
Worse than others	ref.		ref.		ref.		ref.	
Same as others	**1.45**	**(0.22,2.68)**	**1.45**	**(0.23, 2.68)**	**1.36**	**(0.14, 2.58)**	0.91	(-0.29,2.11)
Better than others	**1.35**	**(0.07,2.64)**	**1.36**	**(0.08, 2.65)**	1.25	(-0.03,2.53)	0.55	(-0.74,1.84)
Academic Attainment								
Poor/below average	ref.		ref.		ref.		ref.	
Average	0.35	(-0.69,1.39)	0.35	(-0.69,1.39)	0.36	(-0.68,1.39)	0.03	(-0.97,1.04)
Above average	0.13	(-0.90,1.15)	0.12	(-0.90,1.15)	0.08	(-0.94,1.11)	-0.41	(-1.42,0.60)
Excellent	0.16	(-0.96,1.27)	0.16	(-0.96,1.27)	0.11	(-1.01,1.23)	-0.38	(-1.49,0.72)
Enjoyment of school PE								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-0.25	(-2.16,1.66)	-0.21	(-2.12,1.71)	-0.21	(-2.11,1.70)	-0.29	(-2.13,1.56)
Sometimes	-0.14	(-1.42,1.15)	-0.09	(-1.38,1.21)	-0.26	(-1.56,1.03)	-0.28	(-1.53,0.97)
Quite a lot/very much	-0.06	(-1.27,1.16)	0.01	(-1.23,1.24)	-0.18	(-1.41,1.05)	-0.31	(-1.50,0.88)
Enjoyment of school sports								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	0.59	(-1.27,2.44)	0.63	(-1.23,2.49)	0.55	(-1.30,2.40)	0.87	(-0.92,2.65)
Sometimes	-0.85	(-2.08,0.38)	-0.84	(-2.07,0.39)	-0.92	(-2.14,0.31)	-0.94	(-2.12,0.25)
Quite a lot/very much	-0.43	(-1.57,0.70)	-0.4	(-1.53,0.74)	-0.56	(-1.70,0.57)	-0.59	(-1.69,0.50)
Enjoyment of physical activity								
No	ref.		ref.		ref.		ref.	
Yes	1.09	(-0.65,2.83)	1.09	(-0.65,2.82)	0.92	(-0.83,2.67)	0.39	(-1.31,2.09)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$.

Table 8 Association between childhood school-related factors and reward for men

Variable	Unadjusted		Model 1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
SEI (per unit)	0.30	(-0.15,0.75)	0.34	(-0.11,0.79)	0.32	(-0.13,0.78)	0.24	(-0.22,0.71)
Learner self-concept								
Worse than others	ref.		ref.		ref.		ref.	
Same as others	0.18	(-1.84,2.20)	0.23	(-1.79,2.25)	0.27	(-1.76,2.30)	0.03	(-2.00,2.05)
Better than others	1.22	(-0.86,3.30)	1.25	(-0.83,3.33)	1.29	(-0.80,3.38)	1.02	(-1.10,3.14)
Academic Attainment								
Poor/below average	ref.		ref.		ref.		ref.	
Average	**1.61**	**(0.15,3.07)**	**1.63**	**(0.17,3.09)**	**1.78**	**(0.30,3.26)**	**1.75**	**(0.28,3.23)**
Above average	1.25	(-0.30,2.80)	1.33	(-0.22,2.89)	1.42	(-0.15,2.99)	1.31	(-0.30,2.91)
Excellent	1.31	(-0.68,3.30)	1.31	(-0.67,3.30)	1.46	(-0.56,3.47)	1.25	(-0.79,3.29)
Enjoyment of school PE								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-3.09	(-6.40,0.22)	-3.15	(-6.45,0.16)	**-3.35**	**(-6.67,-0.03)**	**-3.49**	**(-6.80,-0.17)**
Sometimes	-1.83	(-4.21,0.56)	-1.88	(-4.26,0.50)	-2.06	(-4.45,0.34)	-1.96	(-4.34,0.42)
Quite a lot/very much	-0.83	(-3.04,1.38)	-0.85	(-3.06,1.36)	-0.95	(-3.16,1.26)	-0.88	(-3.07,1.31)
Enjoyment of school sports								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-0.80	(-4.40,2.80)	-0.79	(-4.39,2.82)	-0.59	(-4.22,3.03)	-0.16	(-3.79,3.46)
Sometimes	-0.21	(-2.68,2.27)	-0.20	(-2.67,2.28)	-0.06	(-2.55,2.43)	-0.15	(-2.65,2.35)
Quite a lot/very much	0.60	(-1.57,2.77)	0.52	(-1.66,2.69)	0.63	(-1.55,2.81)	0.54	(-1.65,2.74)
Enjoyment of physical activity								
No	ref.		ref.		ref.		ref.	
Yes	2.74	(0.20,5.27)	2.70	(0.16,5.23)	2.87	(0.33,5.42)	2.76	(0.21,5.31)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$.

Table 9 Association between childhood school-related factors and reward for women

Variable	Unadjusted		Model 1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
SEI (per unit)	**0.39**	**(0.02,0.76)**	**0.38**	**(0.01,0.75)**	**0.38**	**(0.01,0.75)**	0.35	(-0.02,0.72)
Learner self-concept								
Worse than others	ref.		ref.		ref.		ref.	
Same as others	-1.50	(-3.42,0.42)	-1.51	(-3.42,0.41)	-1.48	(-3.40,0.44)	-1.69	(-3.63,0.25)
Better than others	-1.40	(-3.41,0.61)	-1.45	(-3.45,0.56)	-1.46	(-3.47,0.55)	-1.95	(-4.03,0.13)
Academic Attainment								
Poor/below average	ref.		ref.		ref.		ref.	
Average	-0.42	(-1.97,1.14)	-0.44	(-1.99,1.11)	-0.36	(-1.92,1.20)	-0.31	(-1.86,1.25)
Above average	-0.39	(-1.93,1.15)	-0.44	(-1.97,1.10)	-0.38	(-1.92,1.17)	-0.38	(-1.93,1.18)
Excellent	0.30	(-1.37,1.98)	0.29	(-1.38,1.96)	0.30	(-1.38,1.99)	0.09	(-1.62,1.80)
Enjoyment of school PE								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	1.88	(-1.10,4.85)	1.67	(-1.31,4.64)	1.75	(-1.25,4.74)	1.66	(-1.32,4.65)
Sometimes	-0.17	(-2.18,1.83)	-0.43	(-2.45,1.58)	-0.26	(-2.29,1.77)	-0.18	(-2.20,1.84)
Quite a lot/very much	0.47	(-1.43,2.36)	0.15	(-1.76,2.07)	0.32	(-1.61,2.25)	0.24	(-1.68,2.17)
Enjoyment of school sports								
Don't do/don't have	ref.		ref.		ref.		ref.	
Not at all/not much	-0.12	(-3.02,2.77)	-0.33	(-3.22,2.57)	-0.21	(-3.12,2.70)	-0.06	(-2.96,2.84
Sometimes	-1.74	(-3.65,0.18)	-1.78	(-3.70,0.13)	-1.68	(-3.61,0.24)	-1.56	(-3.48,0.36)
Quite a lot/very much	-0.53	(-2.30,1.23)	-0.72	(-2.50,1.05)	-0.58	(-2.37,1.20)	-0.59	(-2.37,1.19)
Enjoyment of physical activity								
No	ref.		ref.		ref.		ref.	
Yes	-0.82	(-3.54,1.90)	-0.80	(-3.52,1.92)	-0.77	(-3.52,1.99)	-0.60	(-3.36,2.15)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$.

Childhood SEP

Table 10 and *Table 11* show the association between childhood SEP and ERI for men and women separately. Compared with those that lived in low SEP areas, those men that lived in mid-high SEP areas during childhood had lower ERI and this association was independent of adult SEP (*Table 10*). For women, middle grade paternal occupations were independently associated with lower ERI. The association between frequency of moving and higher ERI was only significant for moving 1-3 times compared to never moving in childhood in women, but this association was weakened by adjusting for adult SEP (*Table 11*).

On the effort scale, those men that lived in mid-high SEP areas had lower effort in adulthood. Living in a larger house independently predicted increased effort in adulthood for men. These associations were unchanged by adjustment for covariates (*Table 12*). For women, lower grade paternal occupation was associated with lower effort, but this association was weakened by adjusting for adult SEP (*Table 13*).

The association between childhood SEP and reward for women was shown in *Table 15*. In general, higher maternal and paternal education levels were related to lower reward. However, in women those whose mother had a manual occupation appeared to have higher reward. All of these associations were unchanged after adjusting for other covariates. There was no association between childhood SEP and reward in adulthood in men in this study (*Table 14*).

Table 10 Association between childhood SEP and log ERI for men

Variable	Unadjusted		Model1		Model 2	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
Maternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	-7	(-15,2)	-7	(-15,2)	-7	(-16,1)
High(≥university)	-2	(-10,6)	-3	(-11,5)	-4	(-12,5)
Paternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	-4	(-11,4)	-4	(-11,4)	-4	(-11,3)
High(≥university)	5	(-3,13)	5	(-3,13)	5	(-3,13)
Maternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	-2	(-10,6)	-2	(-10,6)	-2	(-10,6)
Low (Labourer)	8	(-3,18)	8	(-2,18)	8	(-3,19)
No paid job	2	(-6,10)	2	(-6,10)	2	(-6,10)
Paternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	9	(-6, 23)	9	(-5,23)	9	(-5,23)
Low (Labourer)	-1	(-8, 5)	-1	(-8, 5)	-2	(-8, 5)
No paid job	-7	(-47,33)	-7	(-47,33)	-8	(-48,32)
Rooms in home						
≤7 rooms	ref.		ref.		ref.	
8~10 rooms	4	(-3,11)	4	(-3,11)	4	(-4,11)
>10 rooms	5	(-2,13)	5	(-2,13)	6	(-2,14)
House rental						
Owned	ref.		ref.		ref.	
Rented	-3	(-13, 6)	-3	(-13,7)	-3	(-13, 7)
Unsure	-5	(-54,44)	-5	(-53,44)	-6	(-54,43)
Move frequency						
0 times	ref.		ref.		ref.	
1-3 times	3	(-3,10)	3	(-3,10)	3	(-4,10)
3+ times	0.5	(-9, 8)	0.5	(-9, 8)	-1	(-9, 8)
Siblings						
0-1	ref.		ref.		ref.	
2-3	-3	(-10,4)	-3	(-10,4)	-3	(-10,4)
3+	-6	(-12,1)	-6	(-12,1)	-6	(-12,1)
Area socioeconomic status						
Low	ref.		ref.		ref.	
Mid-low	-10	(-23, 2)	-0.11	(-23, 2)	-11	(-24,2)
Mid high	**-13**	**(-26,-1)**	**-0.14**	**(-27,-1)**	**-14**	**(-27,-1)**
High	-10	(-23, 3)	-0.11	(-24, 2)	-11	(-24,2)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and adult SEP; All bolded values are $p<0.05$.

Table 11 Association between childhood SEP and log ERI for women

Variable	Unadjusted		Model1		Model 2	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
Maternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	2	(-5, 9)	2	(-4, 9)	-0.5	(-7, 6)
High(≥university)	6	(-1,14)	7	(-0.5,14)	2	(-5, 9)
Paternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	-1	(-8, 5)	-1	(-8, 5)	-1	(-8, 5)
High(≥university)	1	(-6,7)	0.5	(-6,7)	-4	(-11,3)
Maternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	-5	(-12, 2)	-5	(-12, 2)	-2	(-9, 5)
Low (Labourer)	-4	(-12, 5)	-4	(-12, 5)	2	(-6, 10)
No paid job	-7	(-14,0.4)	-7	(-14,0.2)	-3	(-10, 4)
Paternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	**-17**	**(-29,-5)**	**-17**	**(-29,-5)**	**-12**	**(-24,-0.3)**
Low (Labourer)	-3	(-9, 2)	-3	(-9, 2)	0.4	(-5, 6)
No paid job	-8	(-44,27)	-8	(-44,27)	-2	(-36, 33)
Rooms in home						
≤7 rooms	ref.		ref.		ref.	
8~10 rooms	-3	(-9, 4)	-3	(-9, 4)	-4	(-11, 2)
>10 rooms	-0.2	(-7, 6)	-0.1	(-7, 6)	-3	(-10, 3)
House rental						
Owned	ref.		ref.		ref.	
Rented	-3	(-11, 5)	-3	(-11, 5)	-2	(-10, 6)
Unsure	-7	(-42,29)	-7	(-42,29)	-15	(-49,20)
Move frequency						
0 times	ref.		ref.		ref.	
1-3 times	**6**	**(0.5,12)**	**6**	**(0.5,12)**	4	(-1,10)
3+ times	3	(-5, 10)	2	(-5, 10)	1	(-6, 8)
Siblings						
0-1	ref.		ref.		ref.	
2-3	1	(-5,6)	1	(-5,6)	2	(-4, 7)
3+	0.1	(-6,6)	0.1	(-6,6)	-0.5	(-6, 5)
Area socioeconomic status						
Low	ref.		ref.		ref.	
Mid-low	7	(-5,19)	8	(-4,20)	4	(-7,16)
Mid high	-5	(-17, 7)	-4	(-16,8)	-8	(-19,4)
High	3	(-10,15)	3	(-9,16)	-3	(-15,9)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and adult SEP; All bolded values are $p<0.05$.

Table 12 Association between childhood SEP and effort for men

Variable	Unadjusted		Model1		Model 2	
	β	95% CI	β	95% CI	β	95% CI
Maternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	-0.56	(-1.39,0.27)	-0.61	(-1.44,0.22)	-0.65	(-1.49,0.19)
High(≥university)	-0.13	(-0.91,0.64)	-0.23	(-1.02,0.56)	-0.34	(-1.15,0.47)
Paternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	-0.30	(-1.00,0.40)	-0.32	(-1.02,0.39)	-0.40	(-1.12,0.31)
High(≥university)	0.49	(-0.26,1.25)	0.43	(-0.34,1.19)	0.34	(-0.46,1.14)
Maternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	-0.31	(-1.11,0.50)	-0.30	(-1.11,0.50)	-0.27	(-1.09,0.54)
Low (Labourer)	0.52	(-0.51,1.55)	0.56	(-0.47,1.60)	0.57	(-0.48,1.62)
No paid job	-0.10	(-0.91,0.71)	-0.08	(-0.89,0.73)	-0.09	(-0.90,0.73)
Paternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	0.92	(-0.47,2.32)	0.95	(-0.45,2.34)	0.95	(-0.45,2.35)
Low (Labourer)	-0.14	(-0.77,0.49)	-0.10	(-0.73,0.54)	-0.05	(-0.72,0.62)
No paid job	-0.18	(-4.14,3.78)	-0.16	(-4.13,3.80)	-0.18	(-4.17,3.80)
Rooms in home						
≤7 rooms	ref.		ref.		ref.	
8~10 rooms	0.41	(-0.32,1.14)	0.40	(-0.34,1.14)	0.39	(-0.35,1.13)
>10 rooms	**0.94**	**(0.20,1.69)**	**0.92**	**(0.16,1.67)**	**0.95**	**(0.17,1.73)**
House rental						
Owned	ref.		ref.		ref.	
Rented	-0.44	(-1.39,0.51)	-0.39	(-1.35,0.57)	-0.38	(-1.35,0.58)
Unsure	-2.90	(-7.70,1.91)	-2.82	(-7.63,2.00)	-2.84	(-7.67,2.00)
Frequency of moving						
0 times	ref.		ref.		ref.	
1-3 times	0.25	(-0.40,0.89)	0.25	(-0.39,0.90)	0.21	(-0.44,0.86)
3+ times	-0.23	(-1.08,0.62)	-0.18	(-1.04,0.68)	-0.21	(-1.07,0.65)
Number of siblings						
0-1	ref.		ref.		ref.	
2-3	-0.19	(-0.87,0.48)	-0.22	(-0.90,0.46)	-0.20	(-0.88,0.48)
3+	-0.60	(-1.28,0.08)	-0.61	(-1.28,0.07)	-0.59	(-1.27,0.09)
Area socioeconomic status						
Low	ref.		ref.		ref.	
Mid-low	-1.19	(-2.41,0.03)	-1.27	(-2.50,-0.03)	-1.27	(-2.52,-0.03)
Mid high	**-1.49**	**(-2.75,-0.22)**	**-1.55**	**(-2.82,-0.28)**	**-1.56**	**(-2.85,-0.27)**
High	-0.90	(-2.17,0.37)	-1.02	(-2.31,0.27)	-1.04	(-2.34,0.27)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and adult SEP; All bolded values are p<0.05.

Table 13 Association between childhood SEP and effort for women

Variable	Unadjusted		Model1		Model 2	
	β	95% CI	β	95% CI	β	95% CI
Maternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	0.21	(-0.45,0.87)	0.20	(-0.46,0.87)	-0.06	(-0.70,0.58)
High(≥university)	0.36	(-0.35,1.08)	0.34	(-0.38,1.07)	-0.19	(-0.92,0.53)
Paternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	-0.36	(-1.00,0.28)	-0.38	(-1.03,0.26)	-0.39	(-1.00,0.23)
High(≥university)	-0.07	(-0.74,0.60)	-0.12	(-0.80,0.57)	-0.58	(-1.26,0.10)
Maternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	-0.26	(-0.95,0.43)	-0.26	(-0.95,0.43)	0.10	(-0.58,0.77)
Low (Labourer)	0.05	(-0.79,0.88)	0.06	(-0.78,0.90)	0.72	(-0.11,1.55)
No paid job	-0.59	(-1.29,0.12)	-0.58	(-1.29,0.13)	-0.16	(-0.85,0.54)
Paternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	**-1.54**	**(-2.77,-0.31)**	**-1.52**	**(-2.75,-0.29)**	-1.04	(-2.24,0.17)
Low (Labourer)	-0.56	(-1.11,0.00)	-0.53	(-1.09,0.03)	-0.15	(-0.72,0.41)
No paid job	-0.64	(-4.23,2.95)	-0.68	(-4.28,2.91)	-0.05	(-3.53,3.44)
Rooms in home						
≤7 rooms	ref.		ref.		ref.	
8~10 rooms	-0.11	(-0.77,0.56)	-0.11	(-0.78,0.55)	-0.27	(-0.91,0.37)
>10 rooms	0.07	(-0.59,0.72)	0.05	(-0.60,0.71)	-0.26	(-0.90,0.37)
House rental						
Owned	ref.		ref.		ref.	
Rented	-0.15	(-0.99,0.69)	-0.15	(-0.99,0.69)	-0.01	(-0.83,0.81)
Unsure	-0.59	(-4.17,2.99)	-0.57	(-4.15,3.01)	-1.36	(-4.82,2.09)
Frequency of moving						
0 times	ref.		ref.		ref.	
1-3 times	0.54	(-0.04,1.12)	0.54	(-0.04,1.12)	0.33	(-0.23,0.89)
3+ times	0.07	(-0.65,0.80)	0.09	(-0.64,0.82)	-0.07	(-0.77,0.64)
Number of siblings						
0-1	ref.		ref.		ref.	
2-3	-0.03	(-0.59,0.54)	-0.02	(-0.58,0.55)	0.10	(-0.45,0.65)
3+	0.11	(-0.49,0.72)	0.13	(-0.48,0.74)	0.09	(-0.50,0.67)
Area socioeconomic status						
Low	ref.		ref.		ref.	
Mid-low	0.79	(-0.38,1.96)	0.81	(-0.36,1.99)	0.50	(-0.64,1.64)
Mid high	-0.29	(-1.49,0.91)	-0.27	(-1.47,0.93)	-0.58	(-1.75,0.58)
High	0.28	(-0.92,1.49)	0.31	(-0.90,1.53)	-0.36	(-1.55,0.82)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and adult SEP; All bolded values are $p<0.05$.

Table 14 Association between childhood SEP and reward for men

Variable	Unadjusted		Model1		Model 2	
	β	95% CI	β	95% CI	β	95% CI
Men						
Maternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	0.64	(-0.76,2.03)	0.57	(-0.82,1.97)	0.56	(-0.84,1.96)
High(≥university)	0.32	(-0.99,1.63)	0.19	(-1.13,1.52)	0.09	(-1.26,1.44)
Paternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	0.74	(-0.43,1.92)	0.69	(-0.49,1.86)	0.46	(-0.73,1.64)
High(≥university)	-0.34	(-1.61,0.93)	-0.54	(-1.83,0.75)	-0.83	(-2.15,0.50)
Maternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	0.07	(-1.27,1.40)	0.07	(-1.26,1.41)	0.15	(-1.18,1.48)
Low (Labourer)	-1.70	(-3.41,0.01)	-1.63	(-3.35,0.09)	-1.53	(-3.25,0.19)
No paid job	-0.94	(-2.28,0.40)	-0.91	(-2.25,0.44)	-0.99	(-2.32,0.34)
Paternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	-0.28	(-2.59,2.02)	-0.23	(-2.54,2.07)	-0.21	(-2.50,2.08)
Low (Labourer)	-0.46	(-1.50,0.58)	-0.37	(-1.42,0.68)	0.04	(-1.06,1.13)
No paid job	3.53	(-3.02,10.07)	3.56	(-2.98,10.11)	4.09	(-2.42,10.59)
Rooms in home						
≤7 rooms	ref.		ref.		ref.	
8~10 rooms	-0.56	(-1.76,0.64)	-0.62	(-1.82,0.59)	-0.65	(-1.85,0.55)
>10 rooms	0.79	(-0.43,2.02)	0.65	(-0.58,1.89)	0.45	(-0.82,1.72)
House rental						
Owned	ref.		ref.		ref.	
Rented	-0.12	(-1.69,1.46)	-0.01	(-1.60,1.58)	-0.03	(-1.61,1.55)
Unsure	**-8.33**	**(-16.29,-0.37)**	**-8.14**	**(-16.10,-0.17)**	-7.61	(-15.52,0.30)
Frequency of moving						
0 times	ref.		ref.		ref.	
1-3 times	-0.61	(-1.68,0.45)	-0.60	(-1.67,0.46)	-0.76	(-1.82,0.30)
3+ times	-0.54	(-1.94,0.86)	-0.44	(-1.86,0.97)	-0.43	(-1.83,0.97)
Number of siblings						
0-1	ref.		ref.		ref.	
2-3	0.50	(-0.62,1.62)	0.42	(-0.71,1.54)	0.37	(0.75,1.48)
3+	0.19	(-0.92,1.31)	0.18	(-0.94,1.29)	0.25	(-0.86,1.36)
Area socioeconomic status						
Low	ref.		ref.		ref.	
Mid-low	0.45	(-1.59,2.50)	0.35	(-1.71,2.42)	0.33	(-1.73,2.39)
Mid high	1.33	(-0.78,3.45)	1.25	(-0.88,3.37)	1.21	(-0.92,3.34)
High	1.91	(-0.21,4.04)	1.76	(-0.39,3.92)	1.60	(-0.56,3.76)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and adult SEP; All bolded values are $p<0.05$.

Table 15 Association between childhood SEP and reward for women

Variable	Unadjusted		Model1		Model 2	
	β	95% CI	β	95% CI	β	95% CI
Maternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	0.07	(-0.92,1.06)	<0.01	(-0.98,0.99)	0.02	(-0.97,1.01)
High(≥university)	**-1.46**	**(-2.53,-0.38)**	**-1.69**	**(-2.77,-0.61)**	**-1.87**	**(-2.98,-0.76)**
Paternal education						
Low (≤12 years)	ref.		ref.		ref.	
Middle(trade/certificate)	**-1.06**	**(-2.01,-0.12)**	**-1.15**	**(-2.09,-0.20)**	**-1.14**	**(-2.09,-0.20)**
High(≥university)	-0.30	(-1.29,0.69)	-0.5	(-1.50,0.51)	-0.59	(-1.63,0.46)
Maternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	0.66	(-0.38,1.70)	0.76	(-0.27,1.80)	0.91	(-0.14,1.96)
Low (Labourer)	**1.58**	**(0.32,2.84)**	**1.78**	**(0.51,3.05)**	**1.94**	**(0.64,3.24)**
No paid job	0.50	(-0.57,1.56)	0.64	(-0.42,1.71)	0.76	(-0.32,1.84)
Paternal occupation						
High (Manager/professional)	ref.		ref.		ref.	
Middle (Clerical)	1.54	(-0.26,3.33)	1.65	(-0.14,3.45)	1.64	(-0.17,3.44)
Low (Labourer)	-0.46	(-1.27,0.36)	-0.31	(-1.13,0.51)	-0.31	(-1.16,0.54)
No paid job	2.50	(-2.75,7.75)	2.26	(-2.99,7.50)	2.10	(-3.13,7.34)
Rooms in home						
≤7 rooms	ref.		ref.		ref.	
8~10 rooms	0.86	(-0.14,1.87)	0.83	(-0.18,1.83)	0.85	(-0.15,1.85)
>10 rooms	0.63	(-0.36,1.62)	0.55	(-0.45,1.54)	0.58	(-0.42,1.58)
House rental						
Owned	ref.		ref.		ref.	
Rented	1.10	(-0.15,2.36)	1.14	(-0.11,2.39)	**1.32**	**(0.06,2.58)**
Unsure	2.27	(-3.06,7.61)	2.42	(-2.91,7.74)	2.58	(-2.71,7.88)
Frequency of moving						
0 times	ref.		ref.		ref.	
1-3 times	-0.34	(-1.21,0.54)	-0.32	(-1.19,0.55)	-0.32	(-1.19,0.55)
3+ times	-0.53	(-1.62,0.56)	-0.41	(-1.50,0.68)	-0.24	(-1.33,0.85)
Number of siblings						
0-1	ref.		ref.		ref.	
2-3	-0.59	(-1.44,0.26)	-0.55	(-1.40,0.30)	-0.57	(-1.41,0.27)
3+	0.05	(-0.86,0.96)	0.13	(-0.78,1.03)	0.19	(-0.71,1.09)
Area socioeconomic status						
Low	ref.		ref.		ref.	
Mid-low	-0.50	(-2.35,1.34)	-0.68	(-2.53,1.17)	-0.47	(-2.32,1.38)
Mid high	0.19	(-1.71,2.09)	0.07	(-1.82,1.97)	0.26	(-1.63,2.15)
High	-0.41	(-2.32,1.50)	-0.61	(-2.52,1.30)	-0.55	(-2.48,1.38)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and adult SEP; All bolded values are $p<0.05$.

Health-related factors

Table 16 and *Table 17* show the association between childhood health-related factors and ERI for men and women separately. In men, worse self-rated fitness compared to peers and poorer self-rated health in childhood was associated with increased ERI in adulthood. These associations were independent of childhood and adulthood SEP measures. Men, who were physical active during childhood for more than 9 hours (540 mins) per week compared to a reference group of less than 3 hours (180 min) per week, had lower ERI in adulthood, independent of childhood and adult-hood SEP (*Table 16*). For women, those that reported worse fitness than peers in childhood reported lower ERI on adult life, but this association was partly explained by child and adult SEP. Being over-weight, drinking alcohol and higher negative affect in childhood were also independently associated with higher ERI in women. The association between smoking in childhood and higher ERI was only apparent in the final model adjusted for adult SEP. There was no association in present study between physical activity and ERI in women (*Table 17*).

For the effort scale, worse self-rated fitness, decreasing self-rated health and drinking in childhood predicted higher effort in men (*Table 18*). Men who did more physical activity in childhood reported reduced effort in adulthood. For women, worse self-rated fitness, over-weight, drinking in childhood and increasing negative affect were associated with higher effort. The association between smoking in childhood and higher effort was only apparent in the final models adjusted for adult SEP. After adjusting for adult SEP, the association between increasing negative affect and increased effort for women was strengthened (*Table 19*).

Poorer self-rated health and increasing negative affect in childhood predicted lower reward for men (*Table 20*). Men that did more physical activity in childhood had increased reward, which was not affected by other factors. For women, overweight and greater negative affect in

childhood were associated with lower reward in adulthood. The association was unchanged after adjusting for covariates(*Table 21*).

Table 22 in appendix shows the association between childhood in-school and out-school physical activity and ERI for men and women separately. Men who spend more minutes of out-school physical activity in childhood reported reduced ERI and increased reward in adulthood. There was no association between childhood either in-school or out-school physical activity and adult ERI, effort and reward in women in this study.

Table *23* in appendix shows the association between those childhood health-related factors that were significantly associated with adult job stress and the additional effect of adjustment for the same risk behaviour in adulthood. For the analysis of the association between childhood BMI and adult job stress, additional adjusted for adult BMI. By analogy, additional adjusted for adult alcohol consumption and physical activity in the analysis of the association between childhood alcohol consumption and total physical activity and adult job stress respectively. The results of these additional analyses show that the association between childhood health risk behaviours and job stress remained statistically significant after adjustment for the same health risk behaviour in adulthood in both men or women.

Table 16 Association between childhood health-related factors and log ERI for men

Variable	Unadjusted		Model1		Model 2		Model 3	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
Self-rated fitness								
Better than others	ref.		ref.		ref.		ref.	
Same as others	**9**	**(2, 17)**	**9**	**(2, 16)**	**10**	**(3,17)**	**10**	**(3, 17)**
Worse than others	3	(-10,16)	3	(-10,17)	3	(-11,16)	3	(-11,16)
Self-rated health*	**5**	**(1, 9)**	**5**	**(1, 9)**	**5**	**(1, 9)**	**5**	**(0.5, 9)**
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	8	(-3, 19)	8	(-3, 19)	8	(-3,19)	8	(-2, 19)
Alcohol Consumption								
No	ref.		ref.		ref.		ref.	
Yes	6	(-0.2,13)	7	(0.1,13)	6	(-0.3,13)	6	(-0.4,13)
Smoking								
No	ref.		ref.		ref.		ref.	
Yes	<0.1	(-12,12)	0.5	(-11,12)	1	(-11,13)	0.4	(-12,13)
Eating breakfast								
Yes	ref.		ref.		ref.		ref.	
No	-3	(-13,7)	-3	(-13,7)	-3	(-13,6)	-3	(-13,7)
Positive affect §	-0.1	(-2, 2)	-0.3	(-2, 2)	-0.4	(-2, 1)	-0.4	(-2, 2)
Negative affect§	1	(-0.4,3)	1	(-0.5,3)	1	(-1, 3)	1	(-1, 3)
Total physical activity								
<180 min	ref.		ref.		ref.		ref.	
180-360 min	-6	(-16, 3)	-6	(-16, 3)	-6	(-16,3)	-6	(-15, 4)
360-540 min	**-15**	**(-26,-4)**	**-15**	**(-26,-4)**	**-14**	**(-25,-3)**	**-15**	**(-26,-3)**
>540 min	**-12**	**(-22,-3)**	**-13**	**(-22,-3)**	**-13**	**(-22,-3)**	**-12**	**(-22,-3)**

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05.
*range: '*very good'* to *'very poor'*
§higher scores mean higher positive/negative affect

Table 17 Association between childhood health-related factors and log ERI for women

Variable	Unadjusted		Model1		Model 2		Model 3	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
Self-rated fitness								
Better than others	ref.		ref.		ref.		ref.	
Same as others	-4	(-12, 3)	-4	(-11, 3)	-3	(-10, 5)	-3	(-7, 7)
Worse than others	**-12**	**(-22,-1)**	**-12**	**(-22,-1)**	**-10**	**(-21,0.1)**	-6	(-16,5)
Self-rated health*	-0.2	(-4, 4)	-0.4	(-4, 3)	<-0.1	(-4,4)	2	(-2, 5)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	**14**	**(5,23)**	**14**	**(5,23)**	**13**	**(4,22)**	**14**	**(5,22)**
Alcohol Consumption								
No	ref.		ref.		ref.		ref.	
Yes	**10**	**(4,16)**	**10**	**(3,16)**	**9**	**(3,15)**	**9**	**(3,15)**
Smoking								
No	ref.		ref.		ref.		ref.	
Yes	8	(-2,17)	6	(-4,16)	7	(-3,17)	**10**	**(1,20)**
Eating breakfast								
Yes	ref.		ref.		ref.		ref.	
No	1	(-6, 9)	1	(-6, 8)	1	(-6, 8)	1	(-6, 8)
Positive affect§	1	(-1, 2)	1	(-1, 2)	1	(-1, 2)	<0.1	(-1, 2)
Negative affect§	**2**	**(1, 3)**	**2**	**(1, 4)**	**2**	**(1, 4)**	**2**	**(1, 4)**
Total physical activity								
<180 min	ref.		ref.		ref.		ref.	
180-360 min	3	(-5,11)	3	(-5,11)	3	(-5,11)	3	(-5,10)
360-540 min	-1	(-10,8)	-2	(-10,7)	-3	(-11,6)	-2	(-11,6)
>540 min	3	(-6,12)	2	(-7,11)	1	(-8,10)	-1	(-10,7)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05;
*range: '*very good'* to *'very poor'*;
§higher scores mean higher positive/negative affect.

Table 18 Association between childhood health-related factors and effort for men

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Self-rated fitness								
Better than others	ref.		ref.		ref.		ref.	
Same as others	**0.86**	**(0.17,1.55)**	**0.85**	**(0.16,1.55)**	**0.88**	**(0.19,1.58)**	**0.89**	**(0.19,1.59)**
Worse than others	0.16	(-1.14,1.46)	0.18	(-1.12,1.48)	0.14	(-1.17,1.44)	0.14	(-1.18,1.47)
Self-rated health*	**0.43**	**(0.02,0.84)**	0.42	(0.00,0.83)	0.39	(-0.03,0.80)	0.40	(-0.02,0.83)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	0.74	(-0.33,1.80)	0.73	(-0.33,1.80)	0.74	(-0.34,1.81)	0.74	(-0.34,1.81)
Alcohol Consumption								
No	ref.		ref.		ref.		ref.	
Yes	**0.76**	**(0.11,1.42)**	**0.81**	**(0.15,1.47)**	**0.76**	**(0.09,1.42)**	**0.77**	**(0.10,1.44)**
Smoking								
No	ref.		ref.		ref.		ref.	
Yes	-0.29	(-1.46,0.88)	-0.22	(-1.40,0.96)	-0.23	(-1.43,0.96)	-0.22	(-1.42,0.99)
Eating breakfast								
Yes	ref.		ref.		ref.		ref.	
No	-0.08	(-1.02,0.87)	-0.07	(-1.02,0.87)	-0.10	(-1.06,0.85)	-0.12	(-1.08,0.84)
Positive affect§	0.01	(-0.18,0.19)	<-0.01	(-0.19,0.18)	-0.02	(-0.21,0.17)	-0.02	(-0.21,0.17)
Negative affect§	0.06	(-0.10,0.22)	0.05	(-0.12,0.21)	0.04	(-0.13,0.20)	0.04	(-0.13,0.21)
Total physical activity								
<180 min	ref.		ref.		ref.		ref.	
180-360 min	-0.44	(-1.37,0.50)	-0.43	(-1.37,0.50)	-0.42	(-1.35,0.52)	-0.43	(-1.37,0.52)
360-540 min	**-1.25**	**(-2.33,-0.16)**	**-1.22**	**(-2.32,-0.13)**	**-1.15**	**(-2.25,-0.05)**	**-1.16**	**(-2.28,-0.05)**
>540 min	-0.93	(-1.87,0.02)	-0.90	(-1.86,0.06)	-0.88	(-1.85,0.08)	-0.89	(-1.86,0.08)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05

*range: '*very good'* to *'very poor'*

§higher scores mean higher positive/negative affect.

Table 19 Association between childhood health-related factors and effort for women

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Self-rated fitness								
Better than others	ref.		ref.		ref.		ref.	
Same as others	-0.29	(-1.01,0.42)	-0.28	(-1.00,0.43)	-0.14	(-0.85,0.58)	0.09	(-0.61,0.78)
Worse than others	-1.12	(-2.16,-0.07)	-1.14	(-2.18,-0.10)	-0.98	(-2.02,0.06)	-0.51	(-1.52,0.51)
Self-rated health*	-0.09	(-0.50,0.32)	-0.05	(-0.42,0.33)	<0.01	(-0.37,0.38)	0.18	(-0.18,0.54)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	**1.07**	**(0.17,1.97)**	**1.07**	**(0.17,1.97)**	**1.02**	**(0.12,1.92)**	**1.03**	**(0.16,1.91)**
Alcohol Consumption								
No	ref.		ref.		ref.		ref.	
Yes	**1.06**	**(0.46,1.66)**	**1.08**	**(0.46,1.70)**	**0.99**	**(0.38,1.61)**	**1.02**	**(0.43,1.62)**
Smoking								
No	ref.		ref.		ref.		ref.	
Yes	0.60	(-0.33,1.53)	0.56	(-0.42,1.53)	0.65	(-0.33,1.63)	**1.03**	**(0.08,1.98)**
Eating breakfast)								
Yes	ref.		ref.		ref.		ref.	
No	0.15	(-0.58,0.89)	0.14	(-0.60,0.87)	0.16	(-0.58,0.89)	0.17	(-0.54,0.87)
Positive affect§	0.09	(-0.08,0.26)	0.09	(-0.07,0.26)	0.08	(-0.08,0.25)	0.08	(-0.08,0.24)
Negative affect§	0.14	(<0.01,0.28)	0.14	(<0.01,0.28)	0.14	(<0.01,0.28)	**0.17**	**(0.03,0.30)**
Total physical activity								
<180 min	ref.		ref.		ref.		ref.	
180-360 min	0.24	(-0.54,1.03)	0.24	(-0.55,1.02)	0.23	(-0.55,1,.01)	0.16	(-0.60,0.91)
360-540 min	-0.28	(-1.16,0.60)	-0.29	(-1.17,0.58)	-0.40	(-1.28,0.47)	-0.37	(-1.22,0.48)
>540 min	0.28	(-0.58,1.14)	0.25	(-0.621.11)	0.14	(-0.73,1.00)	-0.08	(-0.93,0.76)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05

*range: '*very good'* to *'very poor'*

§higher scores mean higher positive/negative affect.

Table 20 Association between childhood health-related factors and reward for men

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Men								
Self-rated fitness								
Better than others	ref.		ref.		ref.		ref.	
Same as others	-0.83	(-1.99,0.34)	-0.84	(-2.01,0.32)	-0.89	(-2.06,0.28)	-0.91	(-2.08,0.26)
Worse than others	-0.93	(-3.11,1.25)	-0.87	(-3.05,1.31)	-0.60	(-2.80,1.60)	-0.51	(-2.71,1.70)
Self-rated health*	**-0.72**	**(-1.41,-0.03)**	**-0.76**	**(-1.45,-0.07)**	-0.69	(-1.39,0.01)	-0.64	(-1.35,0.06)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	-0.15	(-1.92,1.62)	-0.15	(-1.92,1.61)	-0.08	(-1.87,1.70)	-0.18	(-1.96,1.59)
Alcohol Consumption								
No	ref.		ref.		ref.		ref.	
Yes	0.15	(-0.95,1.25)	0.23	(-0.88,1.34)	0.18	(-0.94,1.30)	0.24	(-0.88,1.36)
Smoking								
No	ref.		ref.		ref.		ref.	
Yes	-0.54	(-2.49,1.40)	-0.39	(-2.36,1.57)	-0.59	(-2.60,1.42)	-0.32	(-2.31,1.68)
Eating breakfast								
Yes	ref.		ref.		ref.		ref.	
No	1.40	(-0.18,2.98)	1.40	(-0.18,2.98)	1.52	(-0.07,3.11)	1.39	(-0.20,2.97)
Positive affect§	0.17	(-0.14,0.48)	0.15	(-0.16,0.46)	0.17	(-0.14,0.49)	0.16	(-0.15,0.47)
Negative affect§	**-0.33**	**(-0.60,-0.07)**	**-0.38**	**(-0.65,-0.11)**	**-0.37**	**(-0.64,-0.10)**	**-0.33**	**(-0.60,-0.05)**
Total physical activity								
<180 min	ref.		ref.		ref.		ref.	
180-360 min	1.23	(-0.32,2.78)	1.29	(-0.26,2.84)	1.27	(-0.28,2.83)	1.05	(-0.49,2.58)
360-540 min	**2.23**	**(0.42,4.04)**	**2.46**	**(0.64,4.28)**	**2.50**	**(0.67,4.33)**	**2.59**	**(0.78,4.41)**
>540 min	**1.93**	**(0.36,3.50)**	**2.24**	**(0.64,3.83)**	**2.20**	**(0.60,3.80)**	**2.06**	**(0.48,3.64)**

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05;
*range: '*very good'* to *'very poor'*
§higher scores mean higher positive/negative affect

Table 21 Association between childhood health-related factors and reward for women

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Self-rated fitness								
Better than others	ref.		ref.		ref.		ref.	
Same as others	0.71	(-0.41,1.83)	0.66	(-0.45,1.78)	0.62	(-0.51,1.75)	0.55	(-0.58,1.68)
Worse than others	0.82	(-0.81,2.44)	0.91	(-0.71,2.54)	0.85	(-0.79,2.49)	0.78	(-0.87,2.42)
Self-rated health*	0.12	(-0.47,0.70)	0.18	(-0.41,0.76)	0.18	(-0.41,0.77)	0.23	(-0.36,0.82)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	**-2.24**	**(-3.60,-0.89)**	**-2.22**	**(-3.57,-0.87)**	**-2.18**	**(-3.54,-0.82)**	**-2.23**	**(-3.58,-0.87)**
Alcohol Consumption								
No	ref.		ref.		ref.		ref.	
Yes	-0.49	(-1.43,0.46)	-0.25	(-1.23,0.72)	-0.23	(-1.21,0.75)	-0.11	(-1.09,0.87)
Smoking								
No	ref.		ref.		ref.		ref.	
Yes	-1.3	(-2.76,0.16)	-0.93	(-2.45,0.59)	-0.91	(-2.45,0.64)	-0.85	(-2.40,0.70)
Eating breakfast								
Yes	ref.		ref.		ref.		ref.	
No	0.23	(-0.92,1.37)	0.31	(-0.84,1.46)	0.35	(-0.81,1.50)	0.48	(-0.67,1.63)
Positive affect§	0.06	(-0.20,0.31)	0.04	(-0.22,0.30)	0.04	(-0.22,0.30)	0.04	(-0.22,0.30)
Negative affect§	**-0.48**	**(-0.69,-0.26)**	**-0.50**	**(-0.72,-0.28)**	**-0.50**	**(-0.72,-0.28)**	**-0.48**	**(-0.70,-0.26)**
Total physical activity								
<180 min	ref.		ref.		ref.		ref.	
180-360 min	-0.65	(-1.87,0.58)	-0.63	(-1.85,0.59)	-0.62	(-1.86,0.61)	-0.68	(-1.91,0.55)
360-540 min	-0.86	(-2.23,0.51)	-0.80	(-2.17,0.56)	-0.77	(-2.15,0.61)	-0.79	(-2.17,0.59)
>540 min	-0.28	(-1.62,1.07)	-0.13	(-1.48,1.22)	-0.08	(-1.44,1.28)	-0.05	(-1.42,1.32)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$;
*range: '*very good'* to *'very poor'*
§higher scores mean higher positive/negative affect.

3.4 Discussion

This 25-year follow-up study is the first to explore a broad range of childhood determinants of the total ERI ratio in adult workers. Better school experience (i.e., higher engagement and academic achievement) and some aspects of childhood SEP were found to predict lower adult ERI. Both physical and psychological health in childhood appeared to predict higher ERI in adulthood. Different associations were evident in men and women. The second hypothesis of this study, predicting the mediating effect of adult SEP in the relationship of childhood factors and ERI, was supported in part, mostly in women.

The results of this study suggest that better school experiences in childhood are associated with lower adult ERI. Thus, a life-course perspective is crucial to understand adult job stress. This is supported by previous research which showed that better academic attainment and higher school attendance in childhood were associated with lower job stress in adult life, which was measured with the D-C model [64]. The present study extends this work by indicating that children's rating of their own abilities (i.e., learner self-concept) and how much they enjoy school (i.e., school engagement index) also predict lower adult job stress using the ERI model. The associations between childhood school-related factors and adult job stress could not be explained by adult SEP in men. The possible mechanism of these associations might be that with a better learner self-concept, men have more confidence in their abilities and better social emotional skills, which are useful skills for stress perception and resilience [100, 101]. These skills have been found to be associated with improved stress coping, which may protect against job stress in adulthood [102]. Schools could be claimed to be a microcosm of society, and the findings suggest that children with more positive school experiences might develop into being more engaged in the workplace in adulthood and experience lower job stress.

In line with a previous study, which suggested that higher childhood SEP might predict lower adult job stress using the D-C model [68], a limited number of measures of SEP, such as area-level SEP, were associated with ERI. A negative relationship was found between men that had lived in areas with higher SEP and lower ERI and effort. A positive association was found between women who moved frequently in childhood and higher ERI in adulthood, with this association partly explained by adult SEP. This suggests that childhood SEP may predict adult job stress through multiple life factors, not only by parental SEP in childhood. However, there was not convincing evidence that childhood SEP predicted adult job stress given the inconsistency between markers.

An unexpected relationship of lower childhood SEP in women (i.e., lower paternal occupation status and lower parental education level) and lower effort was found in this study. The results of Hintsa *et al*. support this finding in that they found a relationship between higher parental SEP and higher adult effort in both genders but not in total ERI ratio [63]. The possible mechanism of these associations might be that the childhood environmental-contextual factors, which shape cognitive styles (e.g., beliefs, expectations and aggression) in adolescence might then influence aspiration and self-satisfaction into adulthood [103]. However, many comparisons were made within these analyses and it is therefore also possible that some associations, such as this one, might be spurious.

New evidence on the association between childhood health and adult job stress was found in the present study. First, the findings suggest that childhood self-rated health might predict adult job stress, which has not been found before. Second, health risk behaviours (i.e., physical activity and alcohol consumption) in childhood had a negative impact on future job stress, especially for women, in this study. This association was not found in a similar study to ours in the Young Finns Study [64]. A possible mechanism behind these associations might be that individuals, who experienced better physical health in childhood, were more likely to have

better physical health in adulthood. Such a connection could be through higher productivity and better performance at work, which again could be beneficial for handling perceived job stress [35]. Third, the findings regarding physical activity in childhood and job stress in the Young Finns Study [35] were extended. As before mentioned, Yang *et al.* found that sustained physical activity in leisure time in youth aged 14 years, namely out of school physical activity, was associated with reduced job strain in their midlife. In this study, increased time of total physical activity, including in school and out school physical activity was associated with lower ERI in adulthood. Furthermore, this study also found that boys who did more minutes of out-school physical activity was associated with lower ERI in adulthood. The association between physical activity and job stress could not be explained by adult SEP in either the Young Finns Study or the present study, perhaps due to the influence of SEP on physical activity in adulthood [104]. The positive longitudinal influence of childhood physical activity levels on adult physical activity has been shown in the CDAH study and other cohorts [81, 105]. Moreover, physical activity might enhance the resilience to stress by facilitating neuroplasticity of certain brain structures [106]. Improvements in physical fitness associated with physical activity might improve productivity and the ability to cope with stress and benefit affective stress responses [35, 71]. In additional analysis in this study, the negative impact of childhood health risk behaviours was not affected by adult health risk behaviours. Thus, the association between childhood health risk behaviours and adult job stress might not due to the longitudinal influence of health risk behaviours. The possible mechanism behind the association between childhood health risk behaviours and adult job stress might be that the problem behaviours in childhood was associated with adult mental disorders [95] which was associated with ERI as following discussion. Negative affect in childhood was also associated with higher adult job stress. This relationship was consistent with previous studies with suggestions that individual traits, such as unhealthy emotionality, were associated with different components of ERI in

adults [59, 107]. This may be because people with poorer mental health, as indicated by higher negative affect, may be more likely to have lower educational attainment and less desirable jobs with hazardous work conditions, such as being manual workers [47]. Also, people reporting a greater negative affect in childhood might have a general disposition that also results in greater perceptions of stressors in the workplace as adults [47, 108].

A gender specific pattern of the associations between childhood factors and ERI was found in this study. The results partially supported the 'pathway hypothesis', where adverse childhood health and higher job stress in women was mediated by participants' occupational and educational achievement. The findings suggest that adult SEP can mediate the association of childhood SEP and childhood health with ERI in women whereas this mediation was only shown for childhood SEP and effort before [63]. Additionally, in childhood health-related factors, the negative association between job stress and self-rated health and fitness was more evident in men than women, while the positive association of job stress and negative affect and health risk behaviours (i.e., overweight, alcohol consumption, smoking) was more evident in women than men in present study. Unhealthy emotionality, as indicated by higher negative affect, was associated with more health risk behaviours [109]. The gender specific pattern of the associations between childhood health-related factors and ERI revealed that fitness and health in childhood is potentially more important for future coping ability of stress for men, while emotional health in childhood is more important for future stress responses for women. Furthermore, a recent systematic review found that the association between job stress and mental disorders was more likely to occur in women than men [110]. This might be because women generally have more affective reactivity and greater stress perception than men [21, 111]. They, as a group, also have higher prevalence of mental disorders (e.g., depression) than men [112]. Of note, however, is that women actually had lower ERI when compared to men in

this sample of people. This counters the beliefs of employers in Australia that stress in the workplace is mostly a problem for women [55].

There are several limitations in this study. First, the participants in this study were relatively young (31 to 41 years), which is lower than the peak age at which Australian workers tend to report job stress (44 to 45years) [45]. This was expressed by the range of scores on ERI which were lower than those reported in other studies of working populations [43]. Second, in this CDAH 25-year follow-up study with data collected over three time periods (1985, 2004-05, 2009-11), loss to follow-up was inevitable. Participants and non-participants were compared and it was found that most baseline characteristics were similar. Multiple imputation was also used to replace missing data on covariates to increase the included sample size. Further discussion of the limitations is given in Chapter 5.

There are also several strengths of this study. This is the first longitudinal study on job stress using the ERI model in an Australian population. It is one of the few studies, which due to its design is able to explore the association between a comprehensive range of childhood factors and job stress in adulthood. It adds new evidence on antecedents of job stress in adulthood beyond childhood parental SEP. Another strength of the present study could also be argued to be validity, as this study used the standard ERI model rather than the proxy ERI model as used in some other studies.

In conclusion, this study strengthened the evidence on the associations between a range of childhood factors and ERI in adulthood, with gender differences being observed. The association between childhood factors and adult ERI was partially explained by adult SEP in women in the present study, however, this link was not observed in men. Healthy childhood experiences might lay the foundation for a healthy adult work life. Despite the modest associations, the findings suggest that not only childhood SEP, but also school experience and

health status, might contribute to the development of adult jobs stress. Future studies should consider the effect of pre-employment factors including those from earlier periods in life (childhood and adolescence) in addition to the important impact of more proximal workplace factors in the development of job stress.

Appendix

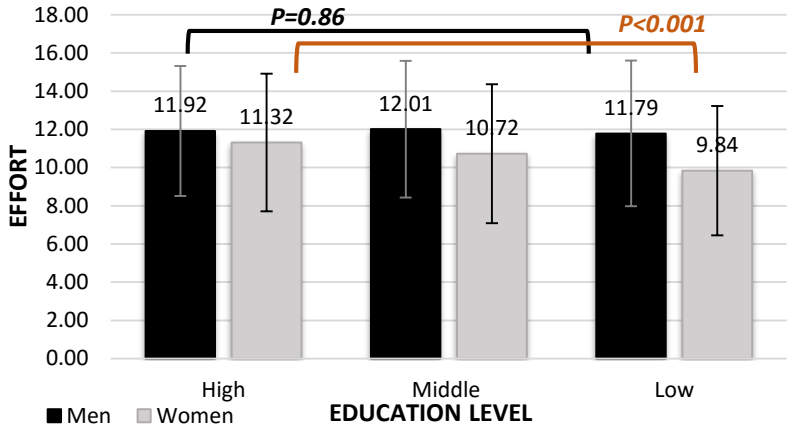
The association between effort, reward and ERI and adult education level

There was no association between adult education level and ERI, effort and reward in men. Education level had a positive association with ERI and effort in women. The association between reward and education level in women was not linear, namely the middle level of education level had lower reward than other groups, while lower education level was associated with lower reward in women (see *Figure 5*).

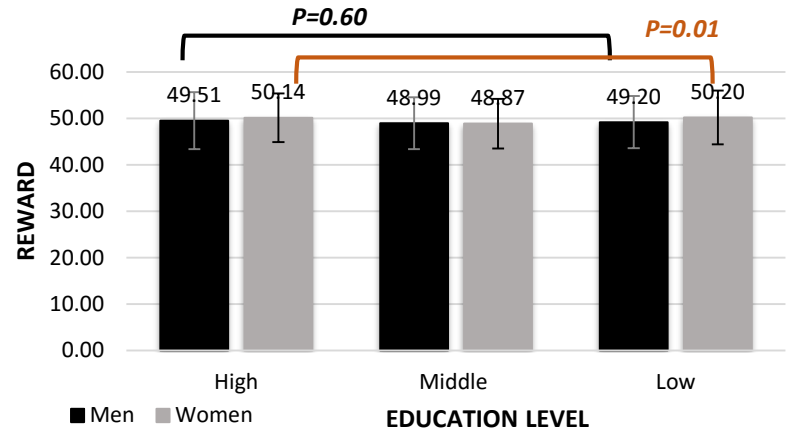
The association between effort, reward and ERI and adult occupation status

There was no association between occupation status and ERI or effort, while lower occupation status was associated with lower reward in men. The association between ERI and effort and occupation status in women was not linear, namely the middle level of occupation groups had lower ERI and effort but higher reward than other groups, while lower occupation status was associated with lower reward in women (see *Figure 6*).

(a)



(b)



(c)

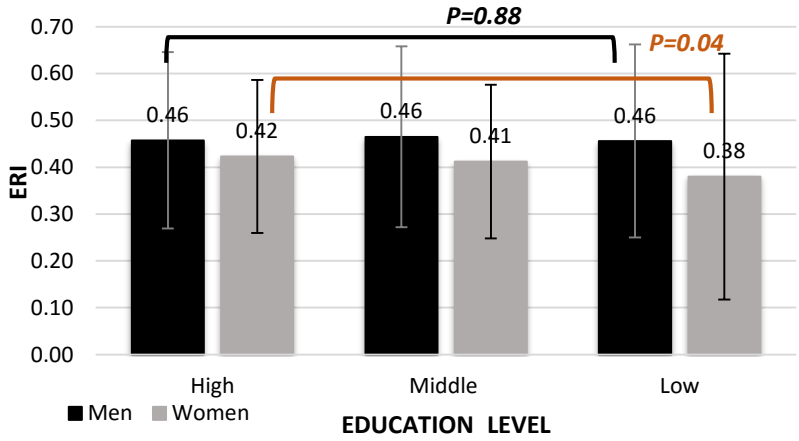


Figure 5 Association between effort (a), reward (b) and ERI ratio (c) and education level for men and women

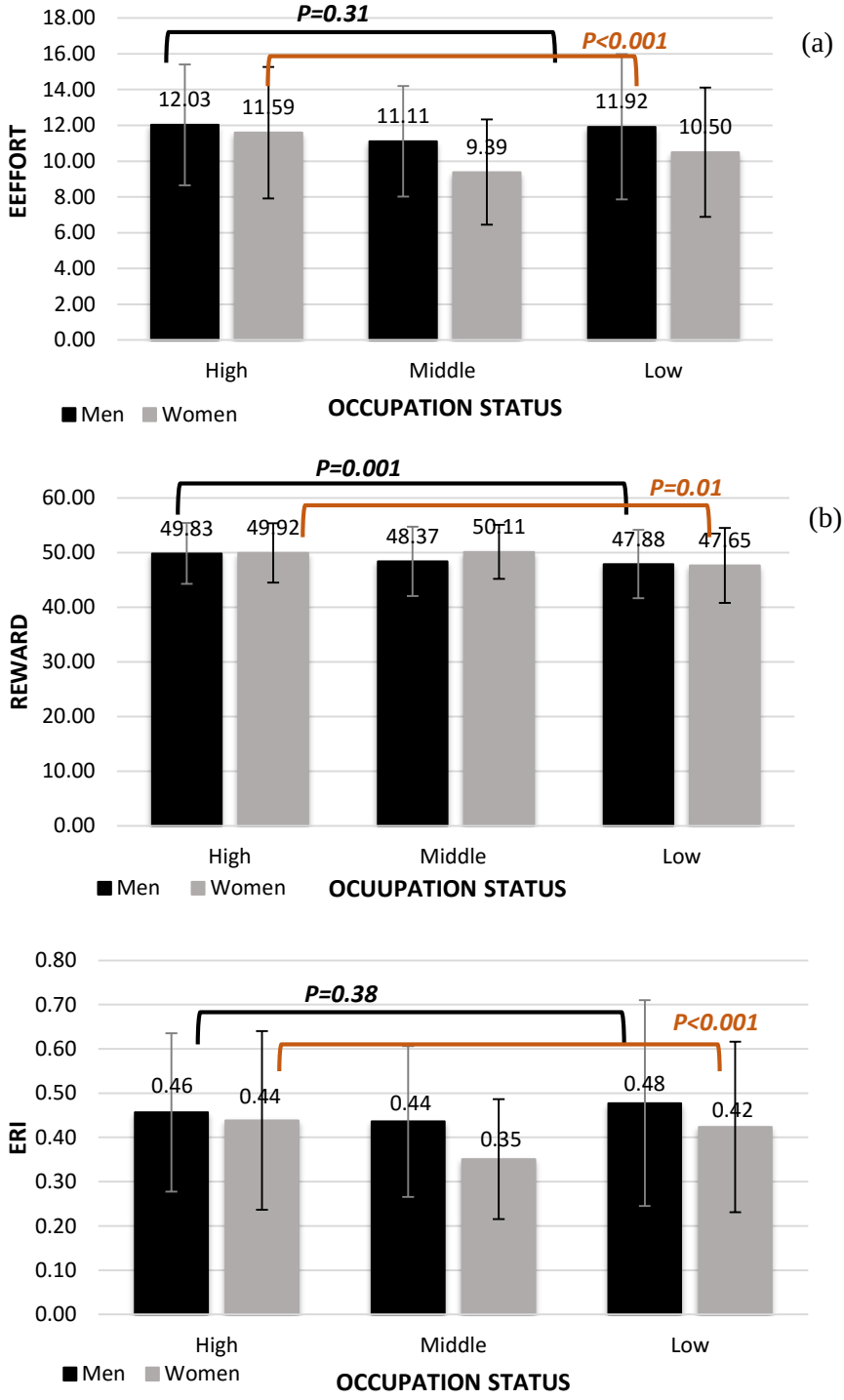


Figure 6 Association between effort (a), reward (b) and ERI ratio (c) and occupation status for men and women

The association between childhood physical activity and ERI, effort and reward for men and women

Table 22 Association between childhood physical activity and ERI(a), effort(b) and reward(c) for men and women

Association between childhood health-related factors and log ERI for men and women (a)

Variable	Unadjusted		Model1		Model 2		Model 3	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
Men								
In-school physical activity mins/week	-0.01	(-0.03,0.01)	-0.01	(-0.03,0.01)	-0.01	(-0.03,0.01)	-0.01	(-0.03,0.01)
Out-school physical activity mins/week	**-0.01**	**(-0.02,<-0.01)**	**-0.01**	**(-0.02,<-0.01)**	**-0.01**	**(-0.02,<-0.01)**	**-0.01**	**(-0.02,<-0.01)**
Women								
In-school physical activity mins/week	<0.01	(-0.02,0.02)	<0.01	(-0.02,0.02)	<0.01	(-0.02,0.02)	<0.01	(-0.02,0.02)
Out-school physical activity mins/week	<0.01	(<0.01,0.01)	<0.01	(<0.01,0.01)	<0.01	(-0.01,0.01)	<0.01	(-0.01,0.01)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05.

Association between childhood health-related factors and effort for men and women (b)

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Men								
In-school physical activity	-0.0011	(-0.0031,0.0008)	-0.0010	(-0.0030,0.0010)	-0.0010	(-0.0030,0.0010)	-0.0010	(-0.0030,0.0010)
Out-school physical activity	-0.0006	(-0.0015,0.0003)	-0.0005	(-0.0014,0.0003)	-0.0005	(-0.0014,0.0004)	-0.0004	(-0.0014,0.0004)
Women								
In-school physical activity	-0.0003	(-0.0023,0.0018)	-0.0003	(-0.0024,0.0017)	-0.0002	(-0.0022,0.0018)	-0.0004	(-0.0023,0.0016)
Out-school physical activity	0.0004	(-0.0004,0.0013)	0.0004	(-0.0004,0.0013)	0.0003	(-0.0005,0.0012)	0.0002	(-0.0007,0.0010)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are p<0.05.

Association between childhood health-related factors and reward for men and women (c)

Variable	Unadjusted		Model1		Model 2		Model 3	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Men								
In-school physical activity	0.0008	(-0.0024,0.0041)	0.0012	(-0.0021,0.0045)	0.0008	(-0.0025,0.0041)	0.0008	(-0.0025,0.0041)
Out-school physical activity	**0.0020**	**(0.0005,0.0034)**	**0.0022**	**(0.0007,0.0037)**	**0.0022**	**(0.0008,0.0037)**	**0.0021**	**(0.0007,0.0036)**
Women								
In-school physical activity	-0.0014	(-0.0046,0.0018)	-0.0011	(-0.0043,0.0021)	-0.0011	(-0.0043,0.0021)	-0.0011	(-0.0043,0.0021)
Out-school physical activity	-0.0002	(-0.0015,0.0011)	-0.0001	(-0.0014,0.0012)	<0.0001	(-0.0013,0.0013)	<0.0001	(-0.0013,0.0013)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; All bolded values are $p<0.05$.

The association between childhood health-related factors and adult job stress with adjustment for adult health risk behaviours

Table 23 Association between childhood health-related factors and adult log ERI (a), effort (b) and reward (c) for men and women with adjustment for adult health risk behaviours

Association between childhood health-related factors and log ERI for men and women(a)

Variable	Unadjusted		Model1		Model 2		Model 3		Model 4	
	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI	% Δ	95% CI
Men										
Alcohol Consumption [a]										
No	ref.		ref.		ref.		ref.		ref.	
Yes	**8**	**(2,15)**	**9**	**(2,16)**	**8**	**(1,15)**	**8**	**(1,15)**	**8**	**(1,15)**
Total physical activity [b]										
<180 min	ref.		ref.		ref.		ref.		ref.	
180-360 min	-5	(-15,5)	-5	(-15,5)	-5	(-15,5)	-4	(-14,6)	-4	(-14,6)
360-540 min	-11	(-22,1)	-11	(-23,1)	-10	(-22,1)	-11	(-23,1)	-10	(-22,1)
>540 min	**-11**	**(-21,-1)**	**-11**	**(-22,-1)**	**-11**	**(-21,-1)**	**-11**	**(-21,-0.2)**	-10	(-20,0.4)
Women										
BMI [c]										
Normal	ref.		ref.		ref.		ref.		ref.	
Overweight	**11**	**(2,20)**	**11**	**(2,21)**	**11**	**(2,20)**	**12**	**(3,20)**	**10**	**(1,20)**
Alcohol Consumption [a]										
No	ref.		ref.		ref.		ref.		ref.	
Yes	**9**	**(3,15)**	**9**	**(2,15)**	**8**	**(1,14)**	**8**	**(2,14)**	**8**	**(2,14)**

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; a: Model 4:Model3+adult alcohol consumption; b: Model 4: Model 3+adult physical activity; c: Model4: Model 3+adult BMI; All bolded values are $p<0.05$.

Association between childhood health-related factors and effort for men(b)

Variable	Unadjusted		Model1		Model 2		Model 3		Model 4	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Men										
Alcohol Consumption [a]										
No	ref.		ref.		ref.		ref.		ref.	
Yes	0.97	(0.31,1.64)	1.02	(0.35,1.69)	0.94	(0.26,1.61)	0.95	(0.27.1.64)	0.98	(0.29,1.67)
Total physical activity [b]										
<180 min	ref.		ref.		ref.		ref.		ref.	
180-360 min	-0.35	(-1.32,0.63)	-0.34	(-1.32,0.63)	-0.31	(-1.28,0.66)	-0.3	(-1.28,0.68)	-0.29	(-1.27,0.69)
360-540 min	-0.84	(-1.98,0.30)	-0.82	(-1.96,0.33)	-0.72	(-1.87,0.43)	-0.78	(-1.94,0.38)	-0.74	(-1.90,0.42)
>540 min	-0.77	(-1.76,0.22)	-0.73	(-1.74,0.27)	-0.69	(-1.70,0.31)	-0.69	(-1.70,0.32)	-0.65	(-1.66,0.37)
Women										
BMI [c]										
Normal	ref.		ref.		ref.		ref.		ref.	
Overweight	0.86	(-0.06,1.79)	0.86	(-0.06,1.79)	0.84	(-0.09,1.76)	0.88	(-0.01,1.78)	0.82	(-0.12,1.75)
Alcohol Consumption [a]										
No	ref.		ref.		ref.		ref.		ref.	
Yes	**0.97**	**(0.36,1.58)**	**0.98**	**(0.35,1.62)**	**0.86**	**(0.23,1.50)**	**0.93**	**(0.32,1.55)**	**0.92**	**(0.30,1.54)**

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; a: Model 4:Model3+adult alcohol consumption; b: Model 4: Model 3+adult physical activity; c: Model4: Model 3+adult BMI; All bolded values are $p<0.05$.

Association between childhood health-related factors and reward for men(c)

Variable	Unadjusted		Model1		Model 2		Model 3		Model 4	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Men										
Alcohol Consumption [a]										
No	ref.		ref.		ref.		ref.		ref.	
Yes	-0.07	(-1.21,1.07)	-0.01	(-1.16,1.14)	-0.04	(-1.21,1.13)	0.03	(-1.14,1.20)	0.06	(-1.12,1.24)
Total physical activity [b]										
<180 min	ref.		ref.		ref.		ref.		ref.	
180-360 min	0.89	(-0.76,2.55)	0.92	(-0.73,2.57)	0.95	(-0.71,2.60)	0.64	(-0.99,2.27)	0.61	(-1.02,2.24)
360-540 min	**1.94**	**(0.01,3.88)**	**2.14**	**(0.20,4.07)**	**2.20**	**(0.24,4.16)**	**2.28**	**(0.35,4.21)**	**2.15**	**(0.22,4.08)**
>540 min	**1.81**	**(0.12,3.49)**	**2.11**	**(0.41,3.82)**	**2.11**	**(0.40,3.83)**	**1.90**	**(0.21,3.58)**	**1.77**	**(0.08,3.45)**
Women										
BMI [c]										
Normal	ref.		ref.		ref.		ref.		ref.	
Overweight	**-1.80**	**(-3.17,-0.42)**	**-1.79**	**(-3.16,-0.42)**	**-1.74**	**(-3.12,-0.37)**	**-1.82**	**(-3.19,-0.45)**	**-1.86**	**(-3.29,-0.43)**
Alcohol Consumption [a]										
No	ref.		ref.		ref.		ref.		ref.	
Yes	-0.47	(-1.44,0.49)	-0.20	(-1.20,0.79)	-0.15	(-1.15,0.85)	-0.04	(-1.03,0.96)	-0.01	(-1.01,0.99)

Model 1: adjusted childhood age; Model 2: adjusted childhood age and childhood SEP; Model 3: Model 2+adult SEP; a: Model 4:Model3+adult alcohol consumption; b: Model 4: Model 3+adult physical activity; c: Model4: Model 3+adult BMI; All bolded values are $p<0.05$.

Chapter 4 The association between effort-reward imbalance and both individual and co-occurring health risk behaviours: Childhood Determinants of Adult Health study

4.1 Introduction

The adverse effects of job stress on physical and mental diseases have been well investigated [6, 7], while the role of health risk behaviours in the association between job stress and health outcomes still remains unclear. Health risk behaviours are the lifestyle habits which harm health, these include smoking, heavy alcohol consumption, poor dietary habits and physical inactivity [113]. These risk behaviours increase the risk of diseases, such as coronary heart disease (CHD), stroke, hypertension and type 2 diabetes [19, 49, 72]. Current estimates suggest that the above mentioned risk behaviours contribute to around 80% of heart disease, stroke and type 2 diabetes worldwide [17]. By contrast, healthy behaviours may improve physical and mental health. For example, more physical activity might be beneficial for reducing the risk of depression [114], and more healthy behaviours are associated with lower risk of cardiovascular diseases [61]. Because health risk behaviours may act as a target for reducing the health effects of job stress, the associations between job stress and health risk behaviours have aroused much attention in recent years.

However, the results of previous studies on the association between job stress and the co-occurrence of health risk behaviours has been inconsistent. The IPD-Work Consortium suggested that the association of job stress with co-occurrence of risk behaviours was similar to the associations of job stress with single behaviours in longitudinal analyses, even though the consortium found that individuals with higher job stress were 34% more likely to have co-occurrence of unhealthy behaviours than those with lower job stress in the D-C model at age 35 to 54 years in cross-sectional analyses [33]. While the FPS study suggested that the associations of job stress with co-occurrence of health risk behaviours is stronger than the

associations with single risk behaviours among workers at age 17 to 63 years [42, 43]. More research is needed to explore the association between job stress and co-occurrence of health risk behaviours. A major limitation of existing studies on the association between job stress and health risk behaviours is that most have been tested using the D-C model. Few studies tested in the ERI model.

One other limitation of the research on job stress and health risk behaviours is the focus on only some of the conventional risk behaviours, like smoking, alcohol consumption, physical inactivity and overweight [33, 42, 43]. Few studies have considered dietary habits. Higher cortisol reactivity in response to stress might drive for more food consumption and high sugar eating, because palatable foods are more likely to act on the brain by activating pleasurable responses [115]. Consuming 'comfort food' might make people feel less stressed, but also might pose a higher risk for poor health, like obesity. A cross-sectional study conducted in 208 male Japanese workers suggested that working in "stressful states" (high job demand and low job latitude) was related to a higher risk of obesity [116]. Unhealthy eating behaviours, such as frequently eating away from home, also contribute to obesity [92]. Whereas eating a good diet might lessen the risk of diseases, For example, fish consumption$\geqslant$ 2 times/week appears to be beneficial for reducing the risk of depression [117] and high fruit and vegetable consumption has been found to be associated with a lower incidence of cardiovascular diseases [118]. Diet is one of the health risk behaviours that is important for prevention of both physical and mental health problems, but few studies have explored the direct association between job stress and diet.

Another limitation is that most studies investigating health behaviours and job stress have been conducted in Europe, especially in Finland [33, 42, 43]. Very little is known outside European populations, and contextual differences like variations in distributions of risk factors, the

workforce and society may result in different associations between these factors. Also, as noted by IPD-Work Consortium studies and the FPS Study [33, 42, 43], some key covariates have not been examined. In particular, many studies lacked information on adverse life events (e.g., divorce, illness financial difficulties and other stressful life experiences) [58, 119] and personality [59, 62] which are associated with both exposures and outcome (health risk behaviours and job stress) and therefore potentially important confounders.

The present study focuses on an Australian cohort with many participants (about 84%) in the workforce and examines the association between ERI and a suite of health risk behaviours, including their co-occurrence, with adjustment for a wide range of potential covariates including socio-demographic and work-related factors, life events and personality. The aim of this study was to examine the associations between ERI and both co-occurrence and single health risk behaviours including dietary behaviours. The primary hypothesis of this study was that higher ERI (higher job stress) would be associated with greater co-occurrence of health risk behaviours (lower healthy lifestyle score).

4.2 Methods

4.2.1 Participants

This study included 1,890 participants and completed the second wave follow-up of the CDAH study (CDAH-2) at ages 31-41 years. The ERI questionnaire was administered in this wave. After excluding participants with incomplete ERI items and without a paid job, 1,481 participants were eligible for inclusion. The final number in some analyses is, however, less than this due to missing data for some of the lifestyle outcome variables and covariates (see *Figure 7*).

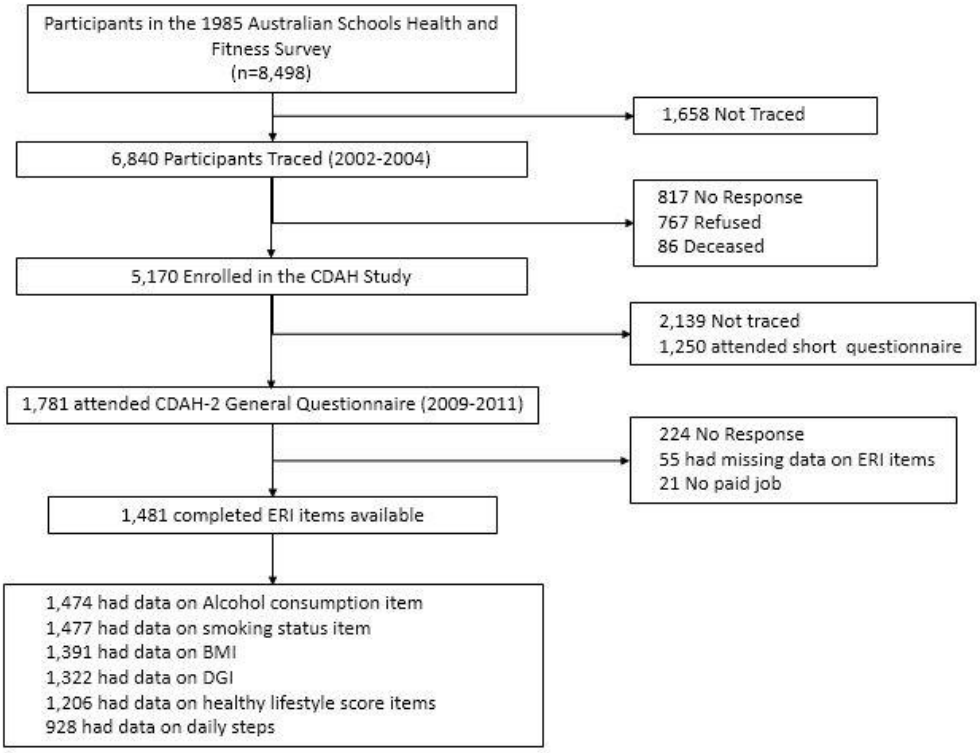


Figure 7 Selection of participants for study 2

4.2.2 Measurements

Outcomes

A Healthy Lifestyle Score was used to measure co-occurrence of health risk behaviours [19, 120]. The Healthy Lifestyle Score sums all items with the total score ranging from 0 (no healthy behaviour) to 10 (all healthy behaviours) [61]. Individual health risk behaviours in this study included smoking status, alcohol consumption, BMI, dietary guideline index (DGI), extra foods consumption, leisure time physical activity, work-related physical activity, domestic and gardening physical activity, transport related physical activity, pedometer steps per day, weekday sitting time and weekend sitting time. All these measures were described in detail in Chapter 2.

Effort-Reward Imbalance

In this study, effort, reward and ERI were as exposure variable and tested separately. The measure of ERI was described in detail in Chapter 2. These were tested as continuous variables.

Covariates

A wide range of potential covariates were considered (see Chapter 2) but only age, education level, occupation status, working hours, work schedule, life events and personality included in models based on purposeful model building. In this study, the five factors were tested separately with only extroversion and agreeableness included in final models as they satisfied criteria for confounding factors as covariates (the standard criteria for confounding factors is described below).

4.2.3 Data analysis

The association between ERI and health risk behaviours was assessed by log multinomial regression (for variables with three or more categories), log binomial regression (for variables with two categories) and linear regression (for continuous variables). For continuous variables, the coefficient of regression (β) and 95% confidence intervals (CI) are reported. For categorical variables, risk ratios (RR) and 95% confidence intervals (CI) are reported. To make it easier to comprehend the results in a meaningful way, the ERI was multiplied by 10 prior to analysis (as this corresponds to 0.1 unit change on the ERI), and divided effort and reward by 5 (as this corresponds to 5 units change on the effort and reward scale). A logarithm transformation was used to correct the kurtosis and skewness of extra food consumption, minutes of LTPA, working physical activity and total alcohol consumption. For minutes of LTPA and working physical activity, for which there were a large number of zero values, binary variables were created to reflect the proportions doing any activity and those doing no activity. Log binomial regression was used to investigate differences between the '*no activity*' and '*any activity*' group. Then, further linear regression analyses were performed on the amount of activity within the

any activity group. In addition to looking at the Healthy Lifestyle Score as a continuous variable, a log multinomial regression model was used to examine associations with low (scores 0 to 4), intermediate (scores 5 to 6) and high (scores 7 to 10) scores by dividing the score into tertiles. The largest group (intermediate with scores 5 to 6) was the reference group. For the daily steps, the log multinomial regression was also used to examine associations with categorised daily steps, and the largest group (somewhat active) was used as the reference group. The preliminary indices by Tudor-Locke were used to classify pedometer steps per day: sedentary lifestyle (<5000 steps/day), low activity (5000-7499 steps/day), somewhat active (7500-9999 steps/day), active ($\geqslant$ 10000 steps/day) and high active (>12500 steps/day) [121].

Data were expressed as mean (SD) for continuous variables and as proportions for categorical variables. The difference between men and women was examined by the Pearson X^2 test. Multiple imputation with chained equations and with 30 estimations was used to impute missing data on covariates. The following variables were used in the imputation model: childhood school academic attainment and smoking status, education level, marital status, sex, age, and state, height, weight and self-rated health from an earlier adult follow-up. Models are presented unadjusted (model 1), adjusted for age (model 2), in addition to model 2 adjusted for work and SEP factors (model 3: working hours, work schedule, education level and occupation status), and additionally adjusted for individual factors (model 4: life events and personality). Details of the association between the effort, reward and ERI and these major confounders are reported in the appendix of this chapter. Only work, SEP and individual factors that satisfied standard criteria for confounding factors (i.e., related to ERI components, the healthy behaviours, and that caused a coefficient change $\geqslant$10%) were included. For simplicity, factors that satisfied these criteria for any outcome were included across all analyses.

Previous study on job stress and health where they considered the effect of SEP found it difficult to separate the effect of each psychosocial factor [43]. To address this, a sensitivity analysis which tested each SEP factor separately was done. Models are presented adjusted for age, personality and education level as the basic model, and additionally adjusted for occupation status, work schedule and working hours separately in different models.

The associations between ERI, effort and reward and each Healthy Lifestyle Score item were also examined and a sensitivity analysis for each of those 10 items was done. The adjusted regression models and SEP models of ERI, effort and reward and each healthy lifestyle score items are presented in the appendix after this chapter.

As previous studies have implied a gender difference in job stress, analyses were performed separately on men and women. Similarly, the total ERI ratio and the individual effort and reward scales were examined. All analysis were conducted with STATA version 12.1 (Statacorp, 2012).

4.3 Results

The characteristics of the participants are described in *Table 24*. There was no difference in mean (SD) age between men and women. Compared to women, men had higher mean [SD] ERI than women (men: mean 0.5 [SD 0.2] vs. women: mean 0.4 [SD 0.2]) (see Chapter 3). Regarding the outcomes, men more often reported having more than 5 drinks per day (men 22.9% vs. women 8.7%), being a current smoker (men 16.4% vs. women 13.0%), having higher levels of working physical activity (measured as mean [SD] minutes) (men: mean 1474.9 [SD 2176.9] vs. women: mean 692.8 [SD 1292.6]), total sitting time on both weekday (men: mean 363.7 [SD 217.1] vs. women: mean 337.3 [SD 192.6]) and weekends(men: mean 272.0 [SD 175.0] vs. women: mean 242.9 [SD 146.0]) and being in the high active category of pedometer steps per day (men 13.5% vs. women 9.0%). Additionally, men had lower mean [SD] DGI

(men: mean 99.5[SD 19.3] vs. women: mean 108.8 [SD 17.2]) and lower healthy lifestyle score (men: mean 5.3 [SD 1.5] vs. women: mean 5.9 [SD 1.4]) than women.

Table 24 Characteristics of men and women aged 31-41 years

Variable	Men		Women		P
	n (%)	mean (SD)	n (%)	mean (SD)	
Age, y	618	36.8(2.5)	36.4(2.6)		0.54
Alcohol consumption	615		859		
None	55(8.9)		113(13.2)		<0.01
1/2 drinks per day	228(37.1)		491(57.2)		
3/4 drinks per day	191(31.1)		180(21.0)		
≥5 drinks per day	141(22.9)		75(8.7)		
Smoking status	616		861		
Never	375(60.9)		499(58.0)		0.01
Ex-smoker	140(22.7)		250(29.0)		
Current smoker	101(16.4)		112(13.0)		
BMI	606		785		
Normal (<25 kg/m^2)	222(36.6)		456(58.1)		<0.01
Overweight (25-29.9 kg/m^2)	284(36.9)		196(25.0)		
Obese (≥30 kg/m^2)	100(16.5)		133(16.9)		
Dietary Guideline Index	590	99.5(19.3)	805	108.8(17.2)	<0.01
LTPA MET mins/week	551	976.9(1279.1)	801	872.3(1031.3)	0.10
Working PA MET mins/week	551	1474.9(2176.9)	801	692.8(1292.6)	<0.01
DGPA MET mins/week	551	797.2(862.5)	801	1106.5(1017.5)	<0.01
Transport related PA MET mins/week	551	434.4(640.4)	801	316.6(488.4)	<0.01
Weekend sitting time (minutes)	610	272.0(175.0)	848	242.9(146.0)	0.02
Weekday sitting time (minutes)	611	363.7(217.1)	848	337.3(192.6)	0.09
Healthy lifestyle score	493	5.3(1.5)	713	5.9(1.4)	<0.01
Low (scores 0 to 4)	143(29.0)		115(16.1)		<0.01
Middle(scores 5 to 6)	240(48.7)		349(49.0)		
High (scores 7 to 10)	110(22.3)		249(34.9)		
Pedometer steps per day	392	8844.37(3276.82)	536	8564.99(3072.44)	
Sedentary lifestyle	33(8.4)		61(11.4)		0.18
Low active	119(30.4)		148(27.6)		0.02
Somewhat active	122(31.1)		157(29.3)		
Active	65(16.6)		122(22.8)		
High active	53 (13.5)		48 (9.0)		

LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity;
The number of participants in some items are different due to missing data for some outcome variables.

Whether the remaining sample in adulthood were similar to the general population (*Table 25*) and if the participants were similar to the general working population [122] of a similar age in Australia were examined to understand the representativeness of the sample. The proportion that reported favourable self-rated health (i.e., good/very good/excellent) was similar in the remaining sample in the CDAH-2 and general population in Australia (remaining sample 92% vs. general population 91%). While the remaining sample in the CDAH-2 were healthier than the general population in Australia with regard to health risk behaviours. More specifically, the remaining sample in the CDAH-2 were less proportion that being a current smoker (remaining sample 17% vs. general population 22%), were greater proportion that consumption adequate fruit and vegetable (remaining sample 12% vs. general population 4%), had normal BMI (remaining sample 46% vs. general population 40%), and did physical activity at a high level (remaining sample 31% vs. general population 15%), but the remaining sample in the CDAH-2 were greater proportion that consuming alcohol exceeded the guideline (>2 standard drinks per day) (remaining sample 37% vs. general population 33%).

However, the participants and general working population in Australia [122] were similar with regard to the proportion that had inadequate fruit and vegetable consumption (participants 89% vs general working population 88% of vegetables and 52% of fruits), the proportion that drank at a risky level (participants 17% vs. general working population 14%), the proportion that were physically inactive (participants , 39% vs. general working population 31%), and the proportion that were obese (BMI> 30kg/m^2) (participants 17% vs. general working population 17%).

Table 25 Comparison of participants in CDAH-2 and general population in similar age in health status

	CDAH-2 Participants		ABS ('000)	
Variable	n	%	n	%
Age	31-41 y		25-44 y	
Self-rated health	2,853		6343.9	
Excellent	475	16.65	1407.4	22.19
Very good	1,175	41.18	2482.6	39.13
Good	964	33.79	1852.6	29.20
Fair	213	7.47	478.6	7.54
Poor	26	0.91	122.7	1.93
Smoking status	3,021		6343.9	
Current smoker	504	16.68	1385.5	21.84
Ex-smoker	837	27.71	1663.1	26.22
Never smoked	1680	55.61	3295.3	51.94
Fruit and vegetable consumption	3,018		6343.9	
Adequate (≥7 times/week)	354	11.73	249.0	3.87
Inadequate (<7 times/week)	2,664	88.27	6,094.9	94.72
Body Mass Index	2,834		5246.0	
Total Normal range (BMI 18.50–24.99)	1,301	45.91	2,060.8	39.28
Overweight (BMI 25.00–29.99)	998	35.22	1,791.9	34.16
Obese (BMI 30.00 or more)	535	18.88	1,336.2	25.47
Alcohol consumption (2009 NHMRC guidelines)	1,779		3916.3	
≤ 2 standard drinks per day	1,120	62.96	2624.4	67.01
>2 standard drinks per day	659	37.04	1281.6	32.72
Physical activity	1,086		6343.9	
Sedentary	109	10.04	2075	32.71
Low	297	27.35	2027	31.96
Moderate	343	31.58	1298	20.46
High	337	31.03	940	14.82

Association between ERI and co-occurring health risk behaviours (Healthy Lifestyle Score)

With the Healthy Lifestyle Score as a measure of co-occurrence of health risk behaviours, linear regression analyses (*Table 26*) adjusted for age, work and SEP factors showed that higher ERI was associated with lower healthy lifestyle score in men (β=-0.07, 95% CI: -0.14 to <0.01) and women (β =-0.07, 95% CI: -0.14 to <0.01) in the present study. After additionally adjusting for individual life events and personality factors, the negative associations were no longer statistically significant. *Table 27* and Table *28* shows the results from log multinomial regression and log binomial regression models for categorised Healthy Lifestyle Score. Higher ERI was associated with less probability of higher Healthy Lifestyle Score (RR: 0.84, 95%CI: 0.73 to 0.96) in men in all models (*Table 27*) but not in women (Table *28*).

For the effort scale, associations between effort and both continuous (*Table 29*) and categorised (*Table 30, Table 31*) Healthy Lifestyle Score were not found in either gender.

For the reward scale, higher reward was related to higher Healthy Lifestyle Score, when analysed continuously using linear regression analyses and adjusting for age, work and SEP factors (β=0.13, 95% CI: 0.02 to 0.25) in men. This relationship was not statistically significant after additionally adjusted for individual life events and personality factors (*Table 32*). Higher reward was associated with less probability of a high Healthy Lifestyle Score (RR: 1.34, 95%CI: 1.09 to 1.64) in men in all models (*Table 33*).There was no association between reward and both continuous and categorised Healthy Lifestyle Score in women (*Table 34*).

Association between ERI and single health risk behaviours

The associations between ERI and specific health risk behaviours are presented in *Table 26* (for continuous variables), Table 27 and Table 28 (for categorical variables). After adjusting

for age, work and SEP factors, higher ERI was associated with lower DGI (β=-0.90, 95% CI: -1.69 to -0.10), more extra foods consumption (β =0.18, 95% CI: 0.06 to 0.30), less minutes of LTPA/week (β =-49.73, 95% CI: -94.47 to -4.99) and more minutes of sitting during the weekend (β =14.75, 95% CI: 7.44 to 22.06) for men, and more pedometer steps per day (β =167.56, 95% CI: 32.84 to 302.28) for women. After additionally adjusting for life events and personality, the negative association still persisted in ERI and more extra foods consumption (β=0.15, 95% CI: 0.03 to 0.27), less minutes of LTPA/week (β =-56.68, 95% CI: -101.82 to -11.55) and more minutes of sitting time during the weekend (β =13.74, 95% CI: 6.33 to 21.15) for men, and more pedometer steps per day (β =179.23, 95% CI: 42.54 to 315.92) for women (*Table 26*). The association between higher ERI and more minutes of sitting time on weekdays only existed when adjusted for age for women (β =7.36, 95% CI: 0.45 to 14.27), but not when other covariates were taken into account. The negative association between ERI and minutes of transport related physical activity only existed in the full adjustment model for women (β =-19.00, 95% CI: -37.70 to -0.31).

Table 27 and Table 28 shows that higher ERI was associated with a higher probability of doing any physical activity in the workplace, both in men (RR: 1.05, 95%CI: 1.00 to 1.11) and women (RR: 1.04, 95% CI: 1.00 to 1.09) in the model adjusting for age. The association was not statistically significant when additionally adjusting for work and SEP factors in men (*Table* 27), and when additionally adjusting for life events and personality in women (*Table 28*). Additionally, ERI was positively associated with the probability of being a current smoker (RR=1.30, 95%CI: 1.19 to 1.42), consuming takeaway food twice a week or more (RR: 1.10, 95%CI: 1.04 to 1.17), and being highly active in pedometer steps per day (RR: 1.46, 95%CI: 1.22 to 1.75) for women. These associations persisted being statistically significant in all models. The association between higher ERI and greater likelihood of higher alcohol

consumption was not statistically significant after adjusting for factors other than age for women (RR=1.16, 95% CI: 1.06 to 1.27).

For the effort scale, the positive association between effort and extra foods consumption (β=0.36, 95% CI: 0.02 to 0.70) and minutes of sitting time during the weekend (β =27.74, 95% CI: 7.18 to 48.30) for men persisted statistically significant in all models (*Table 29*). Higher effort was associated with lower DGI (β =-2.25, 95% CI: -4.45 to -0.05) for men and more minutes of sitting time on weekdays for women (β =28.49, 95% CI: 10.37 to 46.61) and these associations were not statistically significant after adjusting for factors other than age (*Table 29*). The positive association between effort and minutes of physical activity in the workplace (β =198.04, 95% CI: 18.14 to 377.93) and the negative association between effort and minutes of transport related physical activity (β =-56.31, 95% CI: -94.92 to -17.71) existed after adjusting for factors other than age for women. For the categorical variable, effort was positively associated with the probability of being a current smoker (RR=1.52, 95% CI: 1.21 to 1.92) and consuming takeaway food twice a week or more ((RR=1.42, 95% CI: 1.10 to 1.84) in women. These associations persisted in all models (*Table 31*). The association between effort and health risk behaviours were not found in men in categorical variables (*Table 30*).

Higher reward was associated with higher DGI (β =1.42, 95% CI: 0.10 to 2.75), less extra foods consumption (β =-0.21, 95% CI: -0.40 to -0.02) and less minutes of sitting time during the weekend (β =-18.36, 95% CI: -30.58 to -6.15) in men and these associations persisted in all models (*Table 32*). The positive association between reward and more minutes of LTAP/week existed in the unadjusted model (β =84.99, 95% CI: 1.18 to 168.79) for men but not when covariates were taken into account. For the categorical variable, higher reward was associated with less probability of being a current smoker in men (RR=0.86, 95%CI: 0.75 to 0.99) only in models adjusted for age, work and SEP factors, whereas it was found in women in all models (RR=0.86, 95% CI: 0.75 to 0.99) (*Table 34*). Additionally, higher reward was associated with

less probability of consuming takeaway food twice a week or more (RR: 0.80, 95%CI: 0.68 to 0.94) for women, but this association was not statistically significant when additionally adjusting for life events and personality. The association of reward and continuous specific risk factors in women (*Table 34*) and of reward and categorical specific risk behaviours except smoking status in men (*Table 33*) could not be found.

For each Healthy Lifestyle Score items (see *Table 44*, *Table 45* and *Table 46* in Appendix), higher ERI and higher effort were associated with less probability of eating meat less than 5 times per week in men in all models. The association of ERI and effort and each healthy lifestyle items in women could not be found. Reward was positively associated with probability of using skim milk and eating meat less than 5 times per week in men and eating fish more than 2 times per week in women in all models.

Table 26 Adjusted regression models of ERI and health risk behaviours (continuous variable)

	Change in outcome per 0.1 unit change in ERI							
	Unadjusted		Model 1		Model 2		Model 3	
Outcomes	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men								
Total Healthy Lifestyle Score (per unit)	**-0.08**	**(-0.15,-0.01)**	**-0.08**	**(-0.15,-0.01)**	**-0.07**	**(-0.14,<0.01)**	-0.06	(-0.13,0.01)
Dietary Guideline Index	**-1.03**	**(-1.83,-0.23)**	**-1.03**	**(-1.83,-0.23)**	**-0.90**	**(-1.69,-0.10)**	-0.72	(-1.52,0.08)
Extra foods consumption	**0.20**	**(0.08, 0.32)**	**0.20**	**(0.08,0.32)**	**0.18**	**(0.06,0.30)**	**0.15**	**(0.03,0.27)**
LTPA MET mins/week *	**-49.95**	**(-93.07,-6.84)**	**-50.21**	**(-93.40, -7.03)**	**-49.73**	**(-94.47, -4.99)**	**-56.68**	**(-101.82, -11.55)**
Working PA MET mins/week *	31.19	(-56.98,119.35)	37.17	(-56.03,118.37)	28.19	(-41.15, 97.54)	32.71	(-38.73, 104.14)
DGPA MET mins/week*	-8.51	(-34.56,17.53)	-8.94	(-34.57,16.70)	-10.78	(-36.88,15.32)	-11.90	(-38.37,14.57)
Transport related PA MET mins/week*	15.29	(-13.21,43.79)	15.43	(-13.13,44.00)	8.35	(-20.19,36.89)	9.87	(-19.58,39.32)
Weekday sitting time (minutes)	2.35	(-6.59,11.30)	2.32	(-6.51,11.14)	5.50	(-2.79,13.79)	4.16	(-4.17,12.50)
Weekend sitting time (minutes)	**12.61**	**(5.43,19.80)**	**12.60**	**(5.44,19.76)**	**14.75**	**(7.44,22.06)**	**13.74**	**(6.33,21.15)**
Total alcohol consumption, gram/day	0.08	(-0.29,0.45)	0.08	(-0.29,0.45)	-0.01	(-0.38,0.36)	-0.03	(-0.40,0.34)
Pedometer steps per day	-29.93	(-190.25,130.39)	-34.20	(-192.89,124.49)	-71.99	(-229.35, 85.38)	-75.68	(-234.94,83.57)
Women								
Total Healthy Lifestyle Score (per unit)	-0.05	(-0.12,0.01)	-0.05	(-0.12,0.01)	**-0.07**	**(-0.14,<0.01)**	-0.06	(-0.12,0.01)
Dietary Guideline Index	-0.16	(-0.79,0.48)	-0.14	(-0.77,0.49)	-0.23	(-0.87,0.42)	-0.09	(-0.74,0.57)
Extra foods consumption	<0.001	(-0.08,0.07)	-0.01	(-0.08,0.07)	0.03	(-0.05,0.11)	0.02	(-0.06,0.09)
LTPA MET mins/week *	-6.09	(-42.55,30.37)	-6.02	(-42.08,30.04)	-31.65	(-69.51,6.21)	-28.85	(-66.10, 8.40)
Working PA MET mins/week *	19.85	(-29.12,68.81)	19.09	(-29.92,68.10)	30.17	(-16.32,76.66)	25.82	(-21.56,73.20)
DGPA MET mins/week*	3.21	(-27.25,33.67)	1.32	(-28.58,31.23)	25.64	(-6.04,57.32)	22.83	(-9.33,55.00)
Transport related PA MET mins/week*	-7.23	(-25.59,11.13)	-7.41	(-25.71,10.89)	-18.18	(-36.81,0.45)	**-19.00**	**(-37.70,-0.31)**
Weekday sitting time (minutes)	6.97	(0.04, 13.90)	**7.36**	**(0.45,14.27)**	0.01	(-6.90, 6.91)	0.27	(-6.76,7.30)
Weekend sitting time (minutes)	0.73	(-4.50,5.96)	0.79	(-4.45,6.03)	0.06	(-5.45,5.56)	-0.02	(-5.60,5.57)
Total alcohol consumption, gram/day	0.16	(-0.08,0.41)	0.16	(-0.08,0.41)	0.06	(-0.20,0.31)	0.04	(-0.22,0.29)
Pedometer steps per day	**151.84**	**(21.45, 282.23)**	**145.81**	**(15.48,276.15)**	**167.56**	**(32.84, 302.28)**	**179.23**	**(42.54, 315.92)**

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion); *among those participants did any activity; The number of participants ranges from n=336 to n=832.

Table 27 Adjusted regression models of ERI and health risk behaviours (categorical variable) for men

Change in outcome per 0.1 unit change in ERI								
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	0.99	(0.90,1.08)	0.99	(0.90,1.08)	0.98	(0.89,1.07)	0.99	(0.90,1.08)
Current smoker	1.02	(0.92,1.13)	1.02	(0.92,1.12)	1.02	(0.92,1.13)	0.98	(0.88,1.09)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.03	(0.99,1.07)	1.02	(0.99,1.06)	1.01	(0.96,1.05)	1.05	(0.98,1.13)
3/4 drinks per day	0.97	(0.92,1.03)	0.98	(0.92,1.04)	0.98	(0.91,1.05)	0.95	(0.88,1.02)
≥5 drinks per day	1.00	(0.93,1.07)	1.00	(0.93,1.07)	1.01	(0.93,1.10)	1.01	(0.92,1.10)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.07	(0.99,1.14)	1.07	(0.99,1.14)	1.06	(0.98,1.15)	1.05	(0.97,1.14)
Mid (scores 5 to 6)	ref.		ref.		ref.		ref.	
High (score7 to 10)	**0.85**	**(0.74,0.96)**	**0.85**	**(0.74,0.96)**	**0.85**	**(0.74,0.97)**	**0.84**	**(0.73,0.96)**
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	1.05	(0.98,1.13)	1.05	(0.98,1.13)	1.05	(0.97,1.13)	1.04	(0.96,1.12)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.98	(0.93,1.04)	0.98	(0.93,1.04)	0.99	(0.93,1.04)	0.99	(0.93,1.04)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	**1.05**	**(1.00,1.11)**	**1.05**	**(1.00,1.11)**	1.05	(1.00,1.11)	1.05	(1.00,1.11)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.01	(0.96,1.06)	1.01	(0.96,1.06)	1.02	(0.97,1.07)	1.02	(0.97,1.07)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.96	(0.90,1.02)	0.96	(0.90,1.02)	0.96	(0.90,1.03)	0.96	(0.90,1.02)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.01	(0.96,1.06)	1.01	(0.97,1.06)	1.01	(0.96,1.06)	1.02	(0.97,1.07)
Obese	1.02	(0.93,1.12)	1.03	(0.93,1.13)	1.02	(0.92,1.13)	1.00	(0.91,1.11)
Pedometer steps per day								
Sedentary lifestyle	1.00	(0.86,1.16)	1.00	(0.86,1.16)	1.01	(0.86,1.18)	1.00	(0.84,1.18)
Low active	1.01	(0.94,1.08)	1.01	(0.95,1.08)	1.02	(0.95,1.09)	1.03	(0.96,1.10)
Somewhat active	ref.		ref.		ref.		ref.	
Active	1.02	(0.93,1.12)	1.01	(0.92,1.11)	1.01	(0.92,1.12)	1.00	(0.89,1.11)
High active	0.95	(0.83,1.09)	0.94	(0.82,1.07)	0.90	(0.79,1.04)	0.94	(0.82,2.27)

CI: confidence interval; RR: risk ratio; BMI: body mass index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion); The number of participants ranges from n=336 to n=832;

Table 28 Adjusted regression models of ERI and health risk behaviours (categorical variable) for women

Change in outcome per 0.1 unit change in ERI								
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
never	ref.		ref.		ref.		ref.	
Ex-smoker	0.95	(0.89,1.03)	0.96	(0.89,1.03)	0.97	(0.89,1.05)	0.97	(0.89,1.06)
current smoker	**1.23**	**(1.15,1.31)**	**1.23**	**(1.15,1.31)**	**1.28**	**(1.17,1.41)**	**1.30**	**(1.19,1.42)**
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	0.98	(0.94,1.01)	0.98	(0.94,1.01)	0.98	(0.94,1.02)	0.98	(0.94,1.03)
3/4 drinks per day	0.99	(0.92,1.07)	0.99	(0.92,1.07)	0.98	(0.89,1.07)	0.96	(0.86,1.06)
≥5 drinks per day	**1.14**	**(1.05,1.25)**	**1.16**	**(1.06,1.27)**	1.10	(0.99,1.23)	1.15	(0.99,1.34)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.00	(0.89,1.12)	1.00	(0.89,1.12)	1.02	(0.90,1.14)	0.94	(0.83,1.07)
Mid (score 5 to 6)	ref.		ref.		ref.		ref.	
High (score 7 to 10)	0.95	(0.89,1.03)	0.95	(0.89,1.02)	0.93	(0.86,1.01)	0.95	(0.88,1.03)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	**1.10**	**(1.05,1.16)**	**1.11**	**(1.06,1.17)**	**1.12**	**(1.06,1.18)**	**1.10**	**(1.04,1.17)**
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.98	(0.94,1.03)	0.98	(0.94,1.03)	0.98	(0.93,1.03)	0.98	(0.93,1.03)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	**1.04**	**(1.00,1.09)**	**1.04**	**(1.00,1.09)**	**1.05**	**(1.00,1.09)**	1.04	(0.99,1.09)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.96,1.04)	1.00	(0.96,1.04)	1.00	(0.96,1.04)	1.00	(0.96,1.04)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.98	(0.93,1.03)	0.98	(0.93,1.03)	0.98	(0.92,1.03)	0.97	(0.92,1.03)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	0.97	(0.90,1.06)	0.97	(0.90,1.06)	0.99	(0.92,1.08)	1.00	(0.92,1.08)
Obese	1.04	(0.95,1.14)	1.04	(0.95,1.14)	1.04	(0.94,1.14)	1.01	(0.92,1.11)
Pedometer steps per day								
Sedentary lifestyle	0.95	(0.80,1.13)	0.96	(0.81,1.15)	0.93	(0.76,1.13)	0.91	(0.74,1.12)
Low active	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.00	(0.90,1.11)	0.99	(0.89,1.10)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.97	(0.86,1.09)	0.97	(0.86,1.08)	0.97	(0.85,1.10)	0.98	(0.87,1.12)
High active	**1.27**	**(1.09,1.48)**	**1.23**	**(1.06,1.44)**	**1.40**	**(1.18,1.67)**	**1.46**	**(1.22,1.75)**

CI: confidence interval; RR: risk ratio; BMI: body mass index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion); The number of participants ranges from n=336 to n=832.

Table 29 Adjusted regression models of effort and health risk behaviours (continuous variable)

	Change in outcome per 5 units change in effort							
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men								
Total Healthy Lifestyle Score (per unit)	-0.13	(-0.32,0.06)	-0.13	(-0.32,0.06)	-0.11	(-0.30,0.08)	-0.07	(-0.26,0.13)
Dietary Guideline Index	**-2.28**	**(-4.47,-0.08)**	**-2.25**	**(-4.45,-0.05)**	-2.00	(-4.21,0.21)	-1.54	(-3.77,0.69)
Extra foods consumption	**0.48**	**(0.14,0.82)**	**0.48**	**(0.14,0.82)**	**0.44**	**(0.10,0.78)**	**0.36**	**(0.02,0.70)**
LTPA MET mins/week *	-86.85	(-187.27, 13.57)	-89.41	(-189.74, 10.92)	-91.08	(-195.76, 13.61)	-103.27	(-207.19, 0.65)
Working PA MET mins/week *	102.33	(-158.35, 363.01)	104.44	(-153.95, 362.84)	109.96	(-100.76, 320.67)	124.94	(-93.51, 343.39)
DGPA MET mins/week*	8.04	(-64.11,80.19)	7.73	(-63.31,78.77)	0.84	(-71.92,73.61)	-3.56	(-76.62,69.51)
Transport related PA MET mins/week*	20.10	(-53.30,93.50)	20.56	(-53.06,94.19)	-0.78	(-73.03,71.47)	2.40	(-72.24,77.06)
Weekday sitting time (minutes)	11.26	(-13.16, 35.69)	10.16	(-13.94,34.25)	13.22	(-9.70,36.14)	10.30	(-12.72,33.33)
Weekend sitting time (minutes)	**25.20**	**(5.48,44.92)**	**24.71**	**(5.05,44.36)**	**30.26**	**(9.95,50.57)**	**27.74**	**(7.18,48.30)**
Total alcohol consumption, gram/day	0.30	(-0.74,1.35)	0.30	(-0.74, 1.35)	<0.001	(-1.03,1.03)	-0.06	(-1.09,0.97)
Pedometer steps per day	95.49	(-358.49, 549.46)	95.30	(-354.01,544.60)	32.54	(-422.18,487.26)	-11.28	(-471.89,449.34)
Women								
Total Healthy Lifestyle Score (per unit)	-0.10	(-0.24,0.04)	-0.10	(-0.24,0.04)	-0.15	(-0.30,0.01)	-0.13	(-0.29,0.02)
Dietary Guideline Index	-0.29	(-1.95,1.38)	-0.35	(-2.01,1.31)	-0.87	(-2.65,0.91)	-0.70	(-2.48,1.08)
Extra foods consumption	-0.08	(-0.27,0.11)	-0.08	(-0.27,0.11)	0.04	(-0.16,0.25)	0.03	(-0.18,0.24)
LTPA MET mins/week *	-7.79	(-87.72,72.13)	-12.66	(-92.07,66.75)	-77.21	(-156.47,2.06)	-82.18	(-158.79,-5.56)
Working PA MET mins/week *	117.00	(-49.82,283.81)	115.59	(-50.90,282.08)	**198.04**	**(18.14,377.93)**	**187.39**	**(8.30,366.49)**
DGPA MET mins/week*	-19.47	(-98.75,59.80)	-15.92	(-94.29,62.45)	84.54	(-11.17,180.25)	76.51	(-18.81,171.82)
Transport related PA MET mins/week*	-26.41	(-66.40,13.58)	-28.24	(-67.94,11.46)	**-56.31**	**(-94.92,-17.71)**	**-58.45**	**(-96.86,-20.04)**
Weekday sitting time (minutes)	**28.68**	**(10.50,46.87)**	**28.49**	**(10.37,46.61)**	1.25	(-17.66, 20.17)	2.48	(-16.52, 21.48)
Weekend sitting time (minutes)	0.49	(-13.29,14.27)	0.46	(-13.33,14.24)	-2.76	(-17.82,12.30)	-2.32	(-17.41,12.77)
Total alcohol consumption, gram/day	0.46	(-0.13,1.04)	0.46	(-0.13,1.04)	0.18	(-0.42, 0.79)	0.15	(-0.45,0.76)
Pedometer steps per day	186.74	(-174.76,548.18)	185.27	(-175.38,545.93)	293.81	(-96.18,683.81)	278.81	(-111.23,668.84)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion); *among those participants did any activity; The number of participants ranges from n=336 to n=832.

Table 30 Adjusted regression models of effort and health risk behaviours (categorical variable) for men

Change in outcome per 5 units change in effort								
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.01	(0.79,1.29)	1.02	(0.80,1.30)	1.00	(0.78,1.28)	1.05	(0.81,1.35)
Current smoker	0.98	(0.73,1.31)	0.96	(0.71,1.28)	0.96	(0.71,1.29)	0.86	(0.65,1.14)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.11	(0.99,1.24)	1.07	(0.95,1.20)	1.03	(0.90,1.19)	1.11	(0.92,1.34)
3/4 drinks per day	0.92	(0.78,1.08)	0.94	(0.79,1.11)	0.95	(0.78,1.14)	0.89	(0.72,1.09)
≥5 drinks per day	1.01	(0.84,1.22)	1.02	(0.84,1.24)	1.00	(0.83,1.22)	1.04	(0.82,1.31)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.12	(0.90,1.39)	1.12	(0.90,1.39)	1.09	(0.87,1.36)	1.07	(0.86,1.34)
Mid (scores 5 to 6)	ref.		ref.		ref.		ref.	
High (score7 to 10)	0.78	(0.59,1.04)	0.78	(0.59,1.04)	0.79	(2.20,1.06)	0.77	(0.57,1.03)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	1.19	(0.96,1.46)	1.18	(0.96,1.46)	1.18	(0.95,1.47)	1.16	(0.93,1.44)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.01	(0.88,1.16)	1.01	(0.88,1.16)	1.02	(0.88,1.17)	1.02	(0.88,1.18)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.16	(1.00,1.34)	1.16	(1.00,1.34)	1.16	(1.00,1.34)	1.16	(1.00,1.35)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.03	(0.91,1.18)	1.03	(0.91,1.17)	1.06	(0.93,1.21)	1.06	(0.93,1.22)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.91	(0.78,1.07)	0.91	(0.78,1.07)	0.92	(0.78,1.09)	0.91	(0.77,1.08)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.06	(0.93,1.20)	1.07	(0.95,1.21)	1.07	(0.95,1.21)	1.09	(0.96,1.24)
Obese	1.07	(0.82,1.39)	1.08	(0.82,1.41)	1.05	(0.80,1.37)	1.04	(0.79,1.35)
Pedometer steps per day								
Sedentary lifestyle	0.91	(0.56,1.47)	0.93	(0.57,1.52)	0.89	(0.54,1.49)	0.86	(0.49,1.50)
Low active	0.97	(0.77,1.21)	0.99	(0.79,1.24)	0.97	(0.78,1.20)	1.00	(0.80,1.26)
Somewhat active	ref.		ref.		ref.		ref.	
Active	1.21	(0.90,1.62)	1.16	(0.86,1.57)	1.23	(0.90,1.68)	1.17	(0.83,1.64)
High active	0.92	(0.64,1.34)	0.87	(0.59,1.28)	0.85	(0.60,1.21)	0.93	(0.64,1.35)

CI: confidence interval; RR: risk ratio; BMI: body mass index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion);The number of participants ranges from n=336 to n=832

Table 31 Adjusted regression models of effort and health risk behaviours (categorical variable) for women

Change in outcome per 5 units change in effort								
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	0.93	(0.79,1.09)	0.93	(0.79,1.10)	0.98	(0.82,1.17)	0.99	(0.82,1.18)
Current smoker	**1.44**	**(1.18,1.77)**	**1.44**	**(4.23,1.77)**	**1.54**	**(1.20,1.98)**	**1.52**	**(1.21,1.92)**
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	0.97	(0.90,1.06)	0.97	(2.65,1.06)	0.96	(0.87,1.06)	0.99	(0.89,1.09)
3/4 drinks per day	1.00	(0.84,1.20)	1.01	(2.73,1.20)	0.99	(0.79,1.23)	0.96	(0.76,1.21)
≥5 drinks per day	1.26	(0.98,1.62)	1.27	(3.56,1.64)	1.23	(0.88,1.71)	1.08	(0.77,1.53)
Healthy Lifestyle Score								
Low (score 0 to 4)	0.99	(0.76,1.28)	1.00	(2.71,1.29)	1.03	(0.79,1.35)	0.90	(0.71,1.16)
Mid (score 5 to 6)	ref.		ref.		ref.		ref.	
High (score 7 to 10)	0.92	(0.79,1.08)	0.92	(2.51,1.07)	0.88	(0.74,1.04)	0.90	(0.76,1.06)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	**1.48**	**(1.17,1.86)**	**1.47**	**(1.17,1.86)**	**1.46**	**(1.14,1.88)**	**1.42**	**(1.10,1.84)**
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.98	(0.88,1.10)	0.98	(0.88,1.10)	0.97	(0.85,1.09)	0.97	(0.86,1.10)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.14	(0.99,1.30)	1.14	(0.99,1.31)	1.15	(0.99,1.34)	1.14	(0.98,1.33)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.90,1.11)	1.00	(0.90,1.11)	1.01	(0.90,1.13)	1.01	(0.90,1.13)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.95	(0.83,1.08)	0.94	(0.83,1.08)	0.92	(0.80,1.06)	0.91	(0.79,1.05)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	0.95	(0.79,1.14)	0.95	(0.79,1.14)	1.00	(0.83,1.21)	1.01	(0.84,1.21)
Obese	1.05	(0.84,1.31)	1.05	(0.85,1.31)	1.07	(0.85,1.34)	1.01	(0.82,1.24)
Pedometer steps per day								
Sedentary lifestyle	0.80	(0.54,1.18)	0.81	(0.54,1.20)	0.70	(0.45,1.09)	0.69	(0.44,1.09)
Low active	1.11	(0.91,1.36)	1.11	(0.91,1.36)	1.08	(0.86,1.36)	1.07	(0.85,1.34)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.94	(0.73,1.21)	0.94	(0.73,1.21)	0.96	(0.72,1.27)	0.98	(0.74,1.29)
High active	1.13	(0.76,1.69)	1.10	(0.74,1.65)	1.33	(0.83,2.12)	1.34	(0.83,2.16)

CI: confidence interval; RR: risk ratio; BMI: body mass index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion);The number of participants ranges from n=336 to n=832

Table 32 Adjusted regression models of reward and health risk behaviours (continuous variable)

	Change in outcome per 5 units change in reward							
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men								
Total Healthy Lifestyle Score (per unit)	**0.15**	**(0.04,0.26)**	**0.15**	**(0.04,0.26)**	**0.13**	**(0.02,0.25)**	0.11	(-0.01,0.22)
Dietary Guideline Index	**1.97**	**(0.63,3.30)**	**2.00**	**(0.67,3.34)**	**1.71**	**(0.39,3.03)**	**1.42**	**(0.10,2.75)**
Extra foods consumption	**-0.30**	**(-0.49,-0.12)**	**-0.31**	**(-0.49,-0.12)**	**-0.26**	**(-0.44,-0.07)**	**-0.21**	**(-0.40,-0.02)**
LTPA MET mins/week *	**84.99**	**(1.18, 168.79)**	80.98	(-2.79, 164.76)	75.72	(-9.92, 161.36)	88.18	(-0.42, 176.79)
Working PA MET mins/week *	-76.64	(-218.95,65.67)	-71.13	(-212.69,70.43)	-36.33	(152.33, 79.67)	-38.36	(-156.59,79.87)
DGPA MET mins/week*	33.13	(-13.13,79.40)	37.06	(-8.85,82.96)	39.25	(-7.17,85.68)	42.3	(-5.06,89.65)
Transport related PA MET mins/week*	-36.61	(-75.23,2.01)	-37.24	(-75.93,1.45)	-31.78	(-70.81,7.25)	-33.92	(-73.62,5.79)
Weekday sitting time (minutes)	9.83	(-4.95,24.62)	7.94	(-6.67,22.56)	-4.26	(-17.94, 9.42)	-2.21	(-15.92, 11.49)
Weekend sitting time (minutes)	**-15.33**	**(-27.28,-3.39)**	**-16.25**	**(-28.17,-4.34)**	**-19.99**	**(-32.10,-7.89)**	**-18.36**	**(-30.58,-6.15)**
Total alcohol consumption, gram/day	-0.15	(-0.75,0.45)	-0.14	(-0.74, 0.47)	-0.04	(-0.66,0.57)	-0.02	(-0.63,0.60)
Pedometer steps per day	55.48	(-215.03, 325.99)	83.15	(-185.10, 351.41)	173.59	(-90.33, 437.51)	150.13	(-116.18,416.44)
Women								
Total Healthy Lifestyle Score (per unit)	0.08	(-0.01,0.17)	0.08	(-0.02,0.17)	0.07	(-0.03,0.17)	0.03	(-0.06,0.13)
Dietary Guideline Index	0.94	(-0.18,2.06)	0.83	(-0.29,1.95)	0.79	(-0.32,1.90)	0.47	(-0.66,1.60)
Extra foods consumption	-0.07	(-0.22,0.08)	-0.06	(-0.18,0.07)	-0.07	(-0.20,0.05)	-0.05	(-0.18,0.08)
LTPA MET mins/week *	12.12	(-42.42,66.66)	11.99	(-41.98,65.95)	17.00	(-38.14,72.13)	-9.77	(-62.64,43.09)
Working PA MET mins/week *	-39.55	(-128.11,49.01)	-37.60	(-127.08,51.89)	-24.78	(-107.41,57.84)	-20.99	(-105.98,63.99)
DGPA MET mins/week*	4.40	(-49.22,58.02)	15.18	(-38.59,68.96)	10.05	(-42.63,62.73)	10.63	(-43.30,64.57)
Transport related PA MET mins/week*	-5.01	(-30.83,20.82)	-6.56	(-32.25,19.14)	-2.93	(-29.06,23.20)	-3.58	(-30.11,22.95)
Weekday sitting time (minutes)	0.39	(-11.74,12.51)	-1.30	(-13.45,10.86)	-2.74	(-14.43,8.94)	-1.58	(-13.53,10.37)
Weekend sitting time (minutes)	-3.82	(-12.95,5.31)	-4.13	(-13.31,5.06)	-4.04	(-13.34,5.26)	-2.46	(-11.97,7.05)
Total alcohol consumption, gram/day	-0.13	(-0.48,0.21)	-0.13	(-0.48,0.21)	-0.08	(-0.43,0.27)	-0.06	(-0.42,0.30)
Pedometer steps per day	-34.73	(-283.22,213.75)	-4.72	(-254.82, 245.37)	1.18	(-250.33, 252.70)	-52.20	(-306.44,202.05)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion); *among those participants did any activity; The number of participants ranges from n=336 to n=832.

Table 33 Adjusted regression models of reward and health risk behaviours (categorical variable) for men

Change in outcome per 5 units change in reward								
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Men								
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.11	(0.95,1.30)	1.12	(0.95,1.31)	1.17	(0.99,1.38)	1.16	(0.98,1.37)
Current smoker	0.88	(0.76,1.01)	0.88	(0.77,1.01)	**0.86**	**(0.75,0.99)**	0.90	(0.77,1.05)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	0.98	(0.89,1.09)	0.98	(0.89,1.08)	1.02	(0.93,1.11)	0.96	(0.85,1.08)
3/4 drinks per day	0.99	(0.88,1.11)	0.99	(0.88,1.11)	0.99	(0.88,1.12)	1.03	(0.90,1.17)
≥5 drinks per day	1.03	(0.89,1.20)	1.03	(0.89,1.20)	0.97	(0.84,1.13)	1.01	(0.85,1.19)
Healthy Lifestyle Score								
Low (score 0 to 4)	0.94	(0.83,1.06)	0.94	(0.83,1.06)	0.95	(0.84,1.08)	0.98	(0.86,1.12)
Mid (scores 5 to 6)	ref.		ref.		ref.		ref.	
High (score7 to 10)	**1.35**	**(1.11,1.65)**	**1.36**	**(1.11,1.66)**	**1.34**	**(1.09,1.64)**	**1.34**	**(1.09,1.64)**
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	0.96	(0.84,1.09)	0.95	(0.83,1.08)	0.94	(0.83,1.08)	0.96	(0.84,1.10)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.05	(0.96,1.14)	1.05	(0.96,1.14)	1.04	(0.95,1.14)	1.05	(0.96,1.15)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.94	(0.86,1.02)	0.94	(0.86,1.03)	0.97	(0.88,1.06)	0.97	(0.88,1.06)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.93,1.08)	1.00	(0.93,1.08)	0.99	(0.92,1.07)	0.99	(0.91,1.07)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.05	(0.95,1.15)	1.05	(0.95,1.15)	1.04	(0.94,1.15)	1.04	(0.95,1.15)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.04	(0.96,1.13)	1.05	(0.96,1.14)	1.06	(0.97,1.16)	1.04	(0.95,1.14)
Obese	0.94	(0.82,1.09)	0.94	(0.81,1.10)	0.96	(0.82,1.13)	1.00	(0.84,1.18)
Pedometer steps per day								
Sedentary lifestyle	0.99	(0.79,1.24)	0.99	(0.79,1.23)	0.95	(0.75,1.20)	0.96	(0.75,1.23)
Low active	0.96	(0.87,1.06)	0.95	(0.87,1.05)	0.93	(0.85,1.01)	0.92	(0.84,1.01)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.98	(0.85,1.14)	0.99	(0.85,1.15)	1.02	(0.86,1.21)	1.05	(0.88,1.25)
High active	1.04	(0.86,1.26)	1.05	(0.87,1.28)	1.15	(0.95,1.40)	1.08	(0.90,1.30)

CI: confidence interval; RR: risk ratio; BMI: body mass index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion);The number of participants ranges from n=336 to n=832

Table 34 Adjusted regression models of reward and health risk behaviours (categorical variable) for women

Change in outcome per 5 units change in reward								
	Unadjusted		Model 1		Model 2		Model 3	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.06	(0.94,1.18)	1.06	(0.95,1.19)	1.06	(0.95,1.19)	1.06	(0.94,1.18)
Current smoker	0.80	(0.71,0.91)	0.80	(0.70,0.91)	0.83	(0.72,0.95)	0.86	(0.75,0.99)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.02	(0.96,1.08)	1.02	(0.96,1.09)	1.00	(0.95,1.07)	0.98	(0.92,1.05)
3/4 drinks per day	1.06	(0.92,1.21)	1.08	(0.94,1.23)	1.09	(0.94,1.26)	1.14	(0.97,1.35)
≥5 drinks per day	0.90	(0.74,1.10)	0.87	(0.71,1.06)	1.00	(0.84,1.19)	1.01	(0.76,1.34)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.02	(0.85,1.22)	1.02	(0.85,1.23)	1.02	(0.85,1.24)	1.11	(0.91,1.36)
Mid (score 5 to 6)	ref.		ref.		ref.		ref.	
High (score 7 to 10)	1.08	(0.96,1.20)	1.08	(0.96,1.20)	1.08	(0.96,1.20)	1.03	(0.93,1.15)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	**0.83**	**(0.71,0.96)**	**0.80**	**(0.68,0.93)**	**0.80**	**(0.68,0.94)**	0.85	(0.72,1.01)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.01	(0.94,1.09)	1.01	(0.94,1.09)	1.01	(0.93,1.08)	1.00	(0.92,1.07)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.93	(0.85,1.01)	0.93	(0.85,1.02)	0.94	(0.86,1.03)	0.95	(0.87,1.05)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.94,1.07)	1.00	(0.94,1.07)	1.00	(0.94,1.07)	1.01	(0.94,1.08)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.99	(0.91,1.07)	0.98	(0.91,1.07)	0.98	(0.90,1.06)	0.99	(0.90,1.07)
BMI (n=676)								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.05	(0.92,1.20)	1.05	(0.92,1.20)	1.05	(0.92,1.20)	1.05	(0.92,1.21)
Obese	0.90	(0.78,1.05)	0.91	(0.78,1.05)	0.94	(0.81,1.09)	0.98	(0.84,1.15)
Pedometer steps per day								
Sedentary lifestyle	0.84	(0.68,1.03)	0.82	(0.66,1.02)	0.83	(0.67,1.02)	0.86	(0.68,1.07)
Low active	0.99	(0.87,1.13)	0.99	(0.87,1.13)	1.00	(0.87,1.14)	1.03	(0.89,1.18)
Somewhat active	ref.		ref.		ref.		ref.	
Active	1.00	(0.85,1.18)	1.00	(0.85,1.18)	1.00	(0.86,1.18)	0.97	(0.82,1.15)
High active	0.89	(0.69,1.14)	0.92	(0.72,1.17)	0.90	(0.70,1.15)	0.83	(0.64,1.07)

CI: confidence interval; RR: risk ratio; BMI: body mass index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted age; Model 2: Model 1+ individual SEP factors; Model 3: Model2+ individual factors; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion);The number of participants ranges from n=336 to n=832.

Sensitivity analyses with adjustment for different SEP factors on the association between ERI and health risk behaviours

The results of regression models for continuous outcome variables

In a basic model adjusting for age, number of life events, personality and education level, ERI was negatively associated with minutes of LTPA per week (β=-58.58, 95%CI: -102.37 to -14.80) and positively associated with extra food consumption (β=0.17, 95%CI: 0.05 to 0.28) and minutes of sitting time during weekend (β=11.99, 95%CI: 4.75 to 19.23) in men and pedometer steps per day (β=168.14, 95%CI: 35.47 to 300.81) in women. These associations persisted after additionally adjusting for occupation status, work schedule and working hours separately (*Table 35*).

Effort was positively associated with extra food consumption (β=0.39, 95%CI: 0.06 to 0.72) and minutes of sitting time in weekends in basic models (β=23.54, 95%CI: 3.68 to 43.39) in men and these associations persisted after adjusting for socioeconomic factors other than education level (*Table 36*). For women (Table *36*), the positive association between effort and minutes of working physical activity only existed in the model adjusted for age, life events , personality, education level and occupation status (β=203.87, 95%CI: 21.88 to 385.85). The negative association between effort and minutes of transport related physical activity in women only existed in the model additionally adjusted for working hours (β=-56.77, 95%CI: -94.99 to -18.54). Additionally, effort was negatively associated with minutes of LTPA in men and positively associated with minutes of sitting time on weekdays in women, and these associations were not statistically significant in a model additionally adjusted for working hours.

Reward was positively associated with continuous healthy lifestyle score (β=0.12, 95%CI: 0.01 to 0.23), DGI (β=1.35, 95%CI: 0.02 to 2.69) and total minutes of LTPA (β=94.63, 95%CI: 7.31

to 181.96) and was negatively associated with extra food consumption ((β=-0.24, 95%CI: -0.43 to -0.06) and total minutes of sitting time in weekends (β=-15.06, 95%CI: -27.11 to -3.01) in men in the basic model (Table *37*). The associations of reward and extra food consumption, minutes of LTPA and minutes of sitting time in weekend persisted after additionally adjusting for SEP factors other than education. After additionally adjusting for working hours, the positive association between reward and continuous healthy lifestyle score was no longer statistically significant. The negative association between reward and minutes of transport related physical activity in men only existed in the model adjusted for age, life events, personality, education level and occupation status (β=-40.75, 95%CI: -80.15 to -1.34). The positive association between reward and DGI only existed in the model when it was additionally adjusted for work schedule (β=1.35, 95%CI: 0.01 to 2.69). There was no association between reward and continuous health risk behaviours in women.

Table 35 Adjusted SEP models of the association between ERI and health risk behaviours (continuous variable)

	Change in outcome per 0.1 unit change in ERI							
	Model 1		Model 2		Model 3		Model 4	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men								
Total Healthy Lifestyle Score (per unit)	-0.07	(-0.14,<0.01)	-0.07	(-0.14,<0.01)	-0.07	(-0.14,<0.01)	-0.06	(-0.13,0.01)
Dietary Guideline Index	-0.78	(-1.58,0.01)	-0.78	(-1.57,0.02)	-0.79	(-1.58,0.01)	-0.63	(-1.44,0.18)
Extra foods consumption	**0.17**	**(0.05, 0.28)**	**0.16**	**(0.05,0.28)**	**0.17**	**(0.05, 0.28)**	**0.15**	**(0.03, 0.27)**
LTPA MET mins/week *	**-58.58**	**(-102.37,-14.80)**	**-57.69**	**(-101.58,-13.80)**	**-58.51**	**(-102.31,-14.65)**	**-57.63**	**(-102.57,-12.69)**
Working PA MET mins/week *	42.61	(-36.21,121.43)	39.58	(-33.28,112.43)	47.25	(-30.62,125.11)	30.78	(-47.52,109.09)
DGPA MET mins/week*	-10.46	(-36.28,15.36)	-10.13	(-36.02,15.77)	-9.45	(-35.33,16.43)	-13.13	(-39.46,13.20)
Transport related PA MET mins/week*	16.30	(-13.19,45.78)	14.56	(-14.92,44.04)	15.35	(-13.71,44.40)	12.08	(-17.80,41.95)
Weekday sitting time (minutes)	2.30	(-6.26, 10.86)	3.14	(-5.13, 11.42)	1.95	(-6.46, 10.37)	4.01	(-4.75, 12.76)
Weekend sitting time (minutes)	**11.99**	**(4.75,19.23)**	**12.12**	**(4.88,19.36)**	**11.88**	**(4.65,19.10)**	**13.83**	**(6.44,21.22)**
Total alcohol consumption, gram/day	0.05	(-0.32,0.42)	0.06	(-0.32,0.43)	0.05	(-0.32,0.42)	-0.04	(-0.41,0.33)
Pedometer steps per day	-37.63	(-195.26,120.01)	-47.33	(-202.93,108.28)	-35.49	(-193.01,122.03)	-67.17	(-228.55,94.22)
Women								
Total Healthy Lifestyle Score (per unit)	-0.05	(-0.11,0.01)	-0.06	(-0.12,0.01)	-0.05	(-0.11,0.01)	-0.06	(-0.12,0.01)
Dietary Guideline Index	0.04	(-0.62,0.70)	-0.01	(-0.68,0.65)	0.03	(-0.63,0.69)	0.12	(-0.56,0.80)
Extra foods consumption	-0.01	(-0.08,0.07)	0.00	(-0.08,0.07)	-0.01	(-0.08,0.07)	0.01	(-0.07,0.09)
LTPA MET mins/week *	-10.71	(-46.79,25.36)	-15.57	(-51.43,20.29)	-10.81	(-46.85,25.23)	-22.85	(-60.42,14.73)
Working PA MET mins/week *	19.36	(-29.98,68.70)	29.47	(-19.75,78.69)	17.58	(-29.79,64.95)	18.25	(-31.49,67.99)
DGPA MET mins/week*	5.88	(-24.91,36.68)	9.75	(-21.23,40.73)	5.76	(-24.91,36.43)	20.07	(-12.04,52.18)
Transport related PA MET mins/week*	-10.38	(-28.77,8.02)	-10.75	(-29.22,7.71)	-10.41	(-28.83,8.01)	-18.51	(-37.11,0.09)
Weekday sitting time (minutes)	6.56	(-0.53,13.65)	4.76	(-2.31, 11.84)	6.76	(-0.22, 13.74)	1.21	(-5.92, 8.35)
Weekend sitting time (minutes)	0.85	(-4.54,6.23)	0.91	(-4.53,6.34)	0.87	(-4.52,6.26)	-0.82	(-5.63,5.46)
Total alcohol consumption, gram/day	0.12	(-0.13,0.36)	0.10	(-0.15,0.35)	0.11	(-0.13,0.36)	0.06	(-0.19,0.32)
Pedometer steps per day	**168.14**	**(35.47,300.81)**	**173.67**	**(39.92,307.42)**	**167.74**	**(34.99,300.50)**	**173.06**	**(37.52,308.61)**

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832.

Table 36 Adjusted SEP models of the association between effort and health risk behaviours (continuous variable)

	Change in outcome per 5 units change in effort							
	Model 1		Model 2		Model 3		Model 4	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men								
Total Healthy Lifestyle Score (per unit)	-0.10	(-0.29,0.08)	-0.10	(-0.29,0.08)	-0.11	(-0.30,0.08)	-0.07	(-0.26,0.13)
Dietary Guideline Index	-1.94	(-4.12,0.23)	-1.98	(-4.15,0.19)	-1.96	(-4.13,0.22)	-1.45	(-3.68,0.78)
Extra foods consumption	**0.39**	**(0.06,0.72)**	**0.40**	**(0.07,0.73)**	**0.39**	**(0.06,0.72)**	**0.35**	**(0.01,0.69)**
LTPA MET mins/week *	**-104.98**	**(-204.80,-5.15)**	**-106.78**	**(-206.47,-7.10)**	**-104.75**	**(-204.86,-4.64)**	-101.42	(-205.14,2.31)
Working PA MET mins/week *	114.23	(-119.44,347.90)	135.41	(-85.96,356.77)	139.70	(-95.93,375.33)	76.79	(-151.17,304.75)
DGPA MET mins/week*	-0.14	(-70.66,70.38)	-0.27	(-70.88,70.34)	3.57	(-67.50,74.64)	-7.51	(-79.85,64.83)
Transport related PA MET mins/week*	22.09	(-54.56,98.75)	15.44	(-60.60,91.48)	21.42	(-54.12,96.97)	8.30	(-67.88,84.49)
Weekday sitting time (minutes)	10.48	(-12.88, 33.84)	8.16	(-14.45, 30.77)	8.17	(-14.83, 31.17)	16.39	(-7.71,40.50)
Weekend sitting time (minutes)	**23.54**	**(3.68,43.39)**	**23.24**	**(3.37,43.10)**	**22.78**	**(2.94,42.61)**	**29.18**	**(8.72,49.65)**
Total alcohol consumption, gram/day	0.22	(-0.82,1.26)	0.22	(-0.82,1.26)	0.25	(-0.79,1.29)	-0.09	(-1.11,0.93)
Pedometer steps per day	47.67	(-399.32,494.65)	70.71	(-370.46,511.88)	64.28	(-382.90,511.46)	-51.93	(-517.87,414.02)
Women								
Total Healthy Lifestyle Score (per unit)	-0.11	(-0.25,0.03)	-0.12	(-0.27,0.02)	-0.11	(-0.25,0.03)	-0.12	(-0.27,0.03)
Dietary Guideline Index	-0.30	(-2.06,1.47)	-0.47	(-2.26,1.31)	-0.29	(-2.05,1.48)	0.01	(-1.86,1.88)
Extra foods consumption	-0.05	(-0.25,0.14)	-0.04	(-0.24,0.16)	-0.06	(-0.25,0.14)	0.01	(-0.20,0.22)
LTPA MET mins/week *	-34.16	(-110.60,42.29)	-49.84	(-124.96,25.29)	-33.15	(-109.70,43.40)	-65.16	(-143.52,13.19)
Working PA MET mins/week *	157.02	(-17.77,331.81)	**203.87**	**(21.88,385.85)**	143.66	(-22.64,309.95)	159.73	(-22.85,342.30)
DGPA MET mins/week*	5.38	(-76.78,87.54)	19.32	(-64.89,103.53)	6.44	(-75.53,88.41)	63.53	(-30.03,157.09)
Transport related PA MET mins/week*	-35.95	(-75.13,3.23)	-37.51	(-76.88,1.85)	-35.97	(-75.18,3.25)	**-56.77**	**(-94.99,-18.54)**
Weekday sitting time (minutes)	**25.67**	**(7.15,44.19)**	**19.88**	**(1.29, 38.47)**	**25.14**	**(6.90, 43.37)**	6.80	(-12.42, 26.01)
Weekend sitting time (minutes)	1.11	(-13.01,15.22)	1.30	(-12.99,15.59)	1.05	(-13.07,15.17)	-2.50	(-17.43,12.43)
Total alcohol consumption, gram/day	0.35	(-0.24,0.94)	0.30	(-0.29,0.89)	0.36	(-0.23,0.94)	0.22	(-0.39,0.83)
Pedometer steps per day	243.79	(-122.16,609.74)	258.86	(-111.24,628.97)	241.98	(-124.24,608.21)	260.18	(-125.24,645.60)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832.

Table 37 Adjusted SEP models of the association between reward and health risk behaviours (continuous variable)

	Change in outcome per 5 units change in reward							
	Model 1		Model 2		Model 3		Model 4	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men								
Total Healthy Lifestyle Score (per unit)	**0.12**	**(0.01,0.23)**	**0.12**	**(0.01,0.23)**	**0.12**	**(0.01,0.23)**	0.11	(0.00,0.22)
Dietary Guideline Index	**1.35**	**(0.02,2.69)**	1.32	(-0.03,2.67)	**1.35**	**(0.01,2.69)**	1.21	(-0.13,2.55)
Extra foods consumption	**-0.24**	**(-0.43,-0.06)**	**-0.23**	**(-0.41,-0.04)**	**-0.24**	**(-0.43,-0.06)**	**-0.23**	**(-0.42,-0.04)**
LTPA MET mins/week *	**94.63**	**(7.31,181.96)**	**88.45**	**(0.59,176.31)**	**96.05**	**(8.15,183.95)**	**92.84**	**(5.32,180.36)**
Working PA MET mins/week *	-99.24	(-221.47,22.99)	-68.31	(-185.44,48.81)	-84.62	(-207.16,37.93)	-85.01	(-208.45,38.43)
DGPA MET mins/week*	38.91	(-7.73,85.55)	37.88	(-9.09,84.84)	40.94	(-5.87,87.76)	40.54	(-6.34,87.43)
Transport related PA MET mins/week*	-39.26	(-78.88,0.35)	**-40.75**	**(-80.15,-1.34)**	-34.41	(-74.18,5.36)	-36.91	(-76.77,2.96)
Weekday sitting time (minutes)	7.61	(-6.57, 21.80)	1.75	(-12.08, 15.59)	4.63	(-9.38, 18.65)	6.46	(-7.79, 20.71)
Weekend sitting time (minutes)	**-15.06**	**(-27.11,-3.01)**	**-16.15**	**(-28.29,-4.00)**	**-16.24**	**(-28.31,-4.17)**	**-16.20**	**(-28.30,-4.10)**
Total alcohol consumption, gram/day	-0.09	(-0.70,0.52)	-0.12	(-0.73,0.50)	-0.04	(-0.65,0.57)	-0.02	(-0.63,0.59)
Pedometer steps per day	53.93	(-212.58,320.45)	113.05	(-151.78,377.88)	73.88	(-193.83,341.59)	70.74	(-196.24,337.72)
Women								
Total Healthy Lifestyle Score (per unit)	0.04	(-0.06,0.14)	0.04	(-0.06,0.13)	0.04	(-0.06,0.13)	0.04	(-0.06,0.14)
Dietary Guideline Index	0.47	(-0.70,1.64)	0.45	(-0.72,1.62)	0.55	(-0.62,1.72)	0.44	(-0.73,1.61)
Extra foods consumption	-0.03	(-0.16, 0.10)	-0.03	(-0.16, 0.10)	-0.04	(-0.17,0.09)	-0.04	(-0.17,0.09)
LTPA MET mins/week *	-11.24	(-63.63,41.14)	-16.36	(-68.31,35.60)	-8.53	(-61.49,44.43)	-8.42	(-61.02,44.19)
Working PA MET mins/week *	-36.44	(-125.95,53.07)	-32.37	(-119.76,55.02)	-25.85	(-113.18,61.49)	-35.97	(-125.47,53.53)
DGPA MET mins/week*	10.87	(-43.42,65.15)	14.31	(-39.97,68.60)	14.58	(-39.98,69.14)	4.50	(-49.07,58.08)
Transport related PA MET mins/week*	-6.27	(-32.34,19.81)	-6.52	(-32.65,19.60)	-6.27	(-32.51,19.98)	-3.59	(-29.87,22.69)
Weekday sitting time (minutes)	0.53	(-11.88, 12.94)	-0.43	(-12.72, 11.85)	-2.99	(-15.28, 9.30)	2.64	(-9.48,14.77)
Weekend sitting time (minutes)	-2.58	(-11.99,6.83)	-2.56	(-11.98,6.86)	-2.98	(-12.45,6.49)	-2.23	(-11.65,7.19)
Total alcohol consumption, gram/day	-0.10	(-0.46,0.26)	-0.11	(-0.47,0.25)	-0.08	(-0.44,0.28)	-0.09	(-0.44,0.27)
Pedometer steps per day	-48.67	(-301.40,204.06)	-47.14	(-300.20,205.92)	-54.17	(-307.60,199.27)	-48.02	(-301.16,205.13)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832.

The results of regression models for categorical outcome variables

For the categorised variable, higher ERI was associated with lower probability of higher Healthy Lifestyle Score in men (RR: 0.83, 95% CI: 0.73 to 0.96) in the basic model and this association persisted when adjusting for other SEP factors separately (*Table 38*). Additionally, the positive association between ERI and probability of doing any work physical activity existed in the basic model, and also when additionally adjusting for work schedule in men. For women, ERI was positively associated with the probability of being a current smoker, drinking more than 5 drinks per day, consuming takeaway food twice a week or more and being highly active in pedometer steps in all separate models in women (*Table 39*).

Effort was positively associated with the probability of being a current smoker (RR=1.50, 95% CI: 1.23 to 1.84), drinking more than 5 drinks per day (RR=1.37, 95%CI: 1.08 to 1.74) and consuming takeaway food twice a week or more (RR=1.44, 95% CI: 1.13 to 1.84) in the basic model in women (*Table 41*). The positive association of effort and being a current smoker and consuming takeaway food twice a week or more persisted in models additionally adjusted for other SEP factors, while the effect of effort and alcohol consumption was not statistically significant when additionally adjusting for working hours. The association between higher effort and higher probability of doing any physical activity in the workplace (RR: 1.16, 95%CI: 1.01 to 1.34) in women existed in a model additionally adjusted for occupation level but not in the basic model. There was no association between effort and health risk behaviours in categorical variables in men (*Table 40*).

Reward was positively associated with the probability of a high Healthy Lifestyle Score (RR=1.35, 95%CI: 1.10 to 1.64) in men (*Table 42*) and negatively associated with the probability of being a current smoker (RR=0.82, 95% CI: 0.72 to 0.94) in women (*Table 43*)

in the basic model. These associations persisted after adjusting for SEP factors other than education level.

For each Healthy Lifestyle Score item (see *Table 47,Table 48* and *Table 49* in Appendix), higher ERI (RR: 0.82, 95% CI: 0.70 to 0.95) and higher effort (RR: 0.66, 95%CI: 0.47 to 0.93) were associated with less probability of men consuming red meat less than 5 times per week in the basic model and this association persisted when adjusting for other SEP factors separately. The association between ERI and effort and each of Healthy Lifestyle Score items could not be found in women in all models. Reward was positively associated with probability of using skim milk in men in basic model (RR: 1.14, 95%CI: 1.04 to 1.26) and this association persisted when adjusting for other SEP factors separately. The positive association between reward and probability of consuming red meat less than 5 times per week existed when additionally adjusting for occupation and also when additionally adjusting for work schedule in men. For women, reward was positively associated with the probability of consuming fish more than twice per week in the basic model in women (RR: 1.06, 95%CI: 1.01 to 1.11), but this association was not statistically significant when additionally adjusted for work schedule.

Table 38 Adjusted SEP models of the association between ERI and health risk behaviours (categorical variable) for men

Change in outcome per 0.1 unit change in ERI								
	Model 1		Model 2		Model 3		Model 4	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.00	(0.91,1.09)	1.00	(0.91,1.09)	1.00	(0.91,1.10)	0.99	(0.90,1.09)
Current smoker	0.99	(0.90,1.10)	1.00	(0.91,1.09)	0.98	(0.89,1.09)	0.99	(0.89,1.10)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.05	(1.00,1.11)	1.05	(0.99,1.11)	1.05	(0.99,1.12)	1.05	(0.98,1.12)
3/4 drinks per day	0.95	(0.89,1.01)	0.95	(0.90,1.01)	0.93	(0.88,1.00)	0.94	(0.87,1.01)
≥5 drinks per day	1.01	(0.94,1.09)	1.01	(0.94,1.09)	1.02	(0.95,1.10)	1.01	(0.93,1.11)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.06	(0.98,1.14)	1.06	(0.98,1.14)	1.06	(0.98,1.15)	1.05	(0.97,1.13)
Mid (scores 5 to 6)	ref.		ref.		ref.		ref.	
High (score7 to 10)	**0.83**	**(0.73,0.95)**	**0.83**	**(0.73,0.96)**	**0.83**	**(0.72,0.95)**	**0.83**	**(0.73,0.96)**
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	1.04	(0.97,1.12)	1.04	(0.97,1.12)	1.04	(0.97,1.12)	1.04	(0.97,1.12)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.98	(0.93,1.04)	0.98	(0.93,1.04)	0.98	(0.93,1.04)	0.99	(0.93,1.04)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	**1.06**	**(1.00,1.11)**	1.05	(1.00,1.11)	**1.06**	**(1.00,1.12)**	1.05	(1.00,1.11)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.01	(0.96,1.06)	1.01	(0.96,1.06)	1.01	(0.96,1.06)	1.02	(0.97,1.07)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.95	(0.90,1.02)	0.95	(0.90,1.02)	0.95	(0.90,1.02)	0.96	(0.90,1.02)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.02	(0.97,1.06)	1.01	(0.97,1.06)	1.02	(0.97,1.06)	1.02	(0.98,1.07)
Obese	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.01	(0.92,1.11)
Pedometer steps per day								
Sedentary lifestyle	0.99	(0.85,1.16)	1.00	(0.85,1.17)	0.99	(0.84,1.15)	0.99	(0.84,1.16)
Low active	1.01	(0.95,1.08)	1.02	(0.95,1.09)	1.01	(0.95,1.08)	1.01	(0.95,1.08)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.99	(0.89,1.10)	0.99	(0.89,1.09)	0.99	(0.89,1.10)	0.99	(0.89,1.11)
High active	0.98	(0.85,1.13)	1.01	(0.90,1.14)	0.98	(0.85,1.12)	0.93	(0.80,1.08)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832

Table 39 Adjusted SEP models of the association between ERI and health risk behaviours (categorical variable) for women

Change in outcome per 0.1 unit change in ERI								
	Model 1		Model 2		Model 3		Model 4	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	0.98	(0.91,1.06)	0.98	(0.91,1.06)	0.98	(0.91,1.06)	0.98	(0.90,1.06)
Current smoker	**1.30**	**(1.20,1.40)**	**1.30**	**(1.20,1.41)**	**1.32**	**(1.21,1.43)**	**1.27**	**(1.17,1.39)**
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	0.99	(0.96,1.03)	0.99	(0.96,1.03)	0.99	(0.96,1.03)	0.98	(0.94,1.03)
3/4 drinks per day	0.97	(0.90,1.04)	0.97	(0.89,1.05)	0.97	(0.90,1.04)	0.94	(0.86,1.03)
≥5 drinks per day	**1.17**	**(1.07,1.28)**	**1.23**	**(1.10,1.37)**	**1.17**	**(1.07,1.28)**	**1.13**	**(1.01,1.27)**
Healthy Lifestyle Score			1.00		1.00		1.00	
Low (score 0 to 4)	0.96	(0.86,1.08)	0.96	(0.85,1.07)	0.96	(0.86,1.08)	0.95	(0.84,1.08)
Mid (score 5 to 6)	ref.		ref.		ref.		ref.	
High (score 7 to 10)	0.96	(0.89,1.03)	0.95	(0.89,1.02)	0.96	(0.89,1.03)	0.95	(0.88,1.03)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	**1.09**	**(1.03, 1.16)**	**1.10**	**(1.04,1.17)**	**1.09**	**(1.03, 1.16)**	**1.09**	**(1.03, 1.16)**
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.99	(0.94,1.03)	0.98	(0.94,1.03)	0.99	(0.94,1.03)	0.98	(0.94,1.03)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.03	(0.99,1.08)	1.04	(1.00,1.09)	1.04	(0.99,1.08)	1.03	(0.99,1.08)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.96,1.04)	1.00	(0.96,1.04)	1.00	(0.96,1.04)	1.00	(0.96,1.04)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.97	(0.91,1.02)	0.97	(0.91,1.02)	0.97	(0.91,1.02)	0.97	(0.92,1.03)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	0.99	(0.91,1.07)	0.99	(0.92,1.07)	0.99	(0.91,1.07)	1.00	(0.92,1.08)
Obese	1.02	(0.93,1.11)	1.02	(0.93,1.11)	1.02	(0.93,1.11)	1.01	(0.92,1.11)
Pedometer steps per day								
Sedentary lifestyle	0.93	(0.77,1.12)	0.93	(0.77,1.12)	0.94	(0.78,1.13)	0.90	(0.74,1.10)
Low active	1.01	(0.91,1.11)	1.01	(0.91,1.11)	1.00	(0.90,1.10)	1.00	(0.90,1.11)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.97	(0.86,1.10)	0.98	(0.87,1.11)	0.99	(0.87,1.11)	0.96	(0.84,1.09)
High active	**1.39**	**(1.17,1.66)**	**1.39**	**(1.16,1.65)**	**1.38**	**(1.15,1.65)**	**1.48**	**(1.24,1.76)**

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832

Table 40 Adjusted SEP models of the association between effort and health risk behaviours (categorical variable) for men

Change in outcome per 5 units change in effort								
	Model 1		Model 2		Model 3		Model 4	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.04	(0.81,1.34)	1.07	(0.83,1.38)	1.04	(0.81,1.35)	1.01	(0.78,1.31)
Current smoker	0.91	(0.69,1.20)	0.90	(0.68,1.19)	0.89	(0.68,1.16)	0.89	(0.66,1.19)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.13	(0.98,1.30)	1.10	(0.95,1.27)	1.14	(0.98,1.31)	1.11	(0.93,1.32)
3/4 drinks per day	0.88	(0.76,1.03)	0.90	(0.77,1.05)	0.86	(0.72,1.01)	0.86	(0.71,1.04)
≥5 drinks per day	1.06	(0.88,1.28)	1.06	(0.88,1.29)	1.07	(0.89,1.29)	1.08	(0.87,1.35)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.10	(0.88,1.36)	1.10	(0.89,1.36)	1.11	(0.89,1.38)	1.06	(0.85,1.32)
Mid (scores 5 to 6)	ref.		ref.		ref.		ref.	
High (score7 to 10)	0.76	(0.57,1.02)	0.76	(0.57,1.02)	0.76	(0.57,1.02)	0.77	(0.58,1.04)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	1.17	(0.95,1.44)	1.16	(0.94, 1.44)	1.16	(0.94,1.44)	1.16	(0.94,1.45)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.01	(0.87,1.16)	1.00	(0.87,1.16)	1.01	(0.87,1.16)	1.02	(0.88,1.18)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.16	(1.00,1.34)	1.16	(1.00,1.34)	1.16	(1.00,1.35)	1.14	(0.98,1.33)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.04	(0.91,1.18)	1.04	(0.91,1.18)	1.04	(0.91,1.18)	1.06	(0.93,1.21)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.90	(0.77,1.06)	0.90	(0.76,1.05)	0.91	(0.77,1.06)	0.91	(0.77,1.08)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.08	(0.95,1.22)	1.08	(0.95,1.21)	1.08	(0.95,1.22)	1.09	(0.96,1.24)
Obese	1.09	(0.85,1.41)	1.09	(0.85,1.40)	1.10	(0.85,1.43)	1.05	(0.81,1.36)
Pedometer steps per day								
Sedentary lifestyle	0.91	(0.53,1.53)	0.90	(0.53,1.52)	0.87	(0.51,1.50)	0.89	(0.52,1.54)
Low active	0.99	(0.80,1.24)	0.99	(0.79,1.23)	0.99	(0.79,1.24)	1.01	(0.81,1.27)
Somewhat active	ref.		ref.		ref.		ref.	
Active	1.09	(0.79,1.52)	1.09	(0.80,1.50)	1.12	(0.80,1.57)	1.14	(0.81,1.60)
High active	0.96	(0.65,1.41)	1.13	(0.81,1.59)	0.96	(0.65,1.41)	0.83	(0.56,1.22)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832

Table 41 Adjusted SEP models of the association between effort and health risk behaviours (categorical variable) for women

Change in outcome per 5 units change in effort								
	Model 1		Model 2		Model 3		Model 4	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.01	(0.85,1.19)	1.00	(0.84,1.18)	1.01	(0.85,1.19)	1.00	(0.83,1.19)
Current smoker	**1.50**	**(1.23,1.84)**	**1.55**	**(1.26,1.90)**	**1.57**	**(1.27,1.93)**	**1.41**	**(1.13,1.77)**
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.00	(0.93,1.09)	1.01	(0.92,1.10)	1.00	(0.92,1.09)	0.98	(0.89,1.08)
3/4 drinks per day	0.96	(0.79,1.15)	0.96	(0.79,1.18)	0.96	(0.79,1.15)	0.92	(0.73,1.16)
≥5 drinks per day	**1.37**	**(1.08,1.74)**	**1.42**	**(1.10,1.83)**	**1.38**	**(1.09,1.75)**	1.22	(0.90,1.65)
Healthy Lifestyle Score								
Low (score 0 to 4)	0.94	(0.74,1.20)	0.93	(0.74,1.16)	0.94	(0.74,1.20)	0.92	(0.71,1.19)
Mid (score 5 to 6)	ref.		ref.		ref.		ref.	
High (score 7 to 10)	0.92	(0.79,1.07)	0.91	(0.78,1.06)	0.92	(0.79,1.07)	0.91	(0.77,1.07)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	**1.44**	**(1.13,1.84)**	**1.46**	**(1.15, 1.87)**	**1.44**	**(1.13, 1.83)**	**1.40**	**(1.09, 1.81)**
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.98	(0.88,1.10)	0.98	(0.87,1.10)	0.98	(0.88,1.10)	0.97	(0.86,1.10)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.13	(0.98,1.30)	**1.16**	**(1.01,1.34)**	1.13	(0.98,1.30)	1.11	(0.96,1.29)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.90,1.11)	1.00	(0.90,1.11)	1.00	(0.90,1.11)	1.00	(0.90,1.12)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.91	(0.79,1.04)	0.90	(0.79,1.04)	0.91	(0.79,1.04)	0.92	(0.79,1.06)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	0.99	(0.83,1.17)	0.99	(0.84,1.18)	0.99	(0.83,1.17)	1.01	(0.84,1.21)
Obese	1.03	(0.84,1.25)	1.02	(0.84,1.24)	1.02	(0.84,1.25)	1.01	(0.82,1.24)
Pedometer steps per day								
Sedentary lifestyle	0.74	(0.49,1.13)	0.74	(0.49,1.13)	0.76	(0.50,1.16)	0.68	(0.43,1.05)
Low active	1.09	(0.89,1.34)	1.10	(0.89,1.35)	1.07	(0.87,1.31)	1.10	(0.88,1.38)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.95	(0.73,1.24)	0.96	(0.74,1.25)	0.98	(0.75,1.28)	0.92	(0.69,1.21)
High active	1.24	(0.82,1.88)	1.23	(0.81,1.86)	1.20	(0.78,1.83)	1.43	(0.90,2.28)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832

Table 42 Adjusted SEP models of the association between reward and health risk behaviours (categorical variable) for men

Change in outcome per 5 units change in reward								
	Model 1		Model 2		Model 3		Model 4	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.11	(0.94,1.31)	1.16	(0.98,1.37)	1.11	(0.94,1.30)	1.12	(0.95,1.32)
Current smoker	0.90	(0.78,1.05)	0.89	(0.77,1.04)	0.91	(0.78,1.06)	0.91	(0.78,1.05)
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	0.95	(0.85,1.06)	0.95	(0.84,1.06)	0.96	(0.86,1.08)	0.98	(0.86,1.11)
3/4 drinks per day	1.04	(0.92,1.18)	1.04	(0.92,1.18)	1.06	(0.93,1.19)	1.05	(0.91,1.21)
≥5 drinks per day	1.03	(0.89,1.20)	1.03	(0.89,1.20)	0.99	(0.84,1.17)	1.05	(0.90,1.23)
Healthy Lifestyle Score								
Low (score 0 to 4)	0.96	(0.84,1.09)	0.96	(0.84,1.09)	0.96	(0.85,1.10)	0.97	(0.85,1.10)
Mid (scores 5 to 6)	ref.		ref.		ref.		ref.	
High (score7 to 10)	**1.35**	**(1.10,1.64)**	**1.34**	**(1.09,1.64)**	**1.35**	**(1.11,1.65)**	**1.34**	**(1.10,1.64)**
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	0.97	(0.85,1.10)	0.96	(.0.84,1.10)	0.96	(0.84,1.10)	0.97	(0.85,1.11)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.05	(0.96,1.15)	1.05	(0.96,1.15)	1.05	(0.96,1.15)	1.05	(0.96,1.15)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.94	(0.86,1.03)	0.96	(0.87,1.05)	0.95	(0.86,1.04)	0.95	(0.86,1.04)
DGPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.00	(0.92,1.08)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.05	(0.96,1.16)	1.05	(0.95,1.15)	1.06	(0.96,1.17)	1.05	(0.95,1.16)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.04	(0.95,1.14)	1.05	(0.96,1.15)	1.04	(0.95,1.14)	1.04	(0.95,1.13)
Obese	0.98	(0.83,1.15)	0.98	(0.83,1.16)	0.98	(0.83,1.15)	1.00	(0.85,1.18)
Pedometer steps per day								
Sedentary lifestyle	1.01	(0.80,1.28)	0.98	(0.77,1.25)	1.00	(0.80,1.25)	1.01	(0.80,1.28)
Low active	0.96	(0.88,1.06)	0.93	(0.85,1.02)	0.96	(0.88,1.05)	0.96	(0.87,1.05)
Somewhat active	ref.		ref.		ref.		ref.	
Active	1.03	(0.88,1.21)	1.04	(0.88,1.22)	1.04	(0.88,1.22)	1.03	(0.87,1.21)
High active	0.97	(0.80,1.17)	0.99	(0.84,1.18)	0.98	(0.81,1.18)	1.02	(0.85,1.23)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are $p<0.05$; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832

Table 43 Adjusted SEP models of the association between reward and health risk behaviours (categorical variable) for women

Change in outcome per 5 units change in reward								
	Model 1		Model 2		Model 3		Model 4	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Smoking status								
Never	ref.		ref.		ref.		ref.	
Ex-smoker	1.05	(0.94,1.18)	1.05	(0.94,1.18)	1.05	(0.94,1.18)	1.06	(0.94,1.18)
Current smoker	**0.82**	**(0.72,0.94)**	**0.83**	**(0.72,0.95)**	**0.84**	**(0.73,0.96)**	**0.84**	**(0.74,0.95)**
Alcohol consumption								
None	ref.		ref.		ref.		ref.	
1/2 drinks per day	1.00	(0.94,1.06)	0.99	(0.93,1.05)	1.00	(0.94,1.06)	0.99	(0.93,1.05)
3/4 drinks per day	1.10	(0.96,1.27)	1.11	(0.95,1.30)	1.11	(0.97,1.28)	1.14	(0.98,1.32)
≥5 drinks per day	0.85	(0.71,1.03)	0.90	(0.72,1.13)	0.83	(0.68,1.01)	0.93	(0.75,1.17)
Healthy Lifestyle Score								
Low (score 0 to 4)	1.10	(0.91,1.34)	1.10	(0.90,1.34)	1.10	(0.91,1.34)	1.11	(0.91,1.35)
Mid (score 5 to 6)	ref.		ref.		ref.		ref.	
High (score 7 to 10)	1.04	(0.93,1.16)	1.04	(0.93,1.16)	1.04	(0.93,1.16)	1.04	(0.93,1.16)
Take away food consumption/week								
1 or less	ref.		ref.		ref.		ref.	
2 or more	0.85	(0.72,1.00)	0.85	(0.72,1.00)	0.84	(0.71,1.00)	0.85	(0.72,1.01)
LTPA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.00	(0.93,1.08)	1.00	(0.93,1.08)	1.00	(0.92,1.07)	1.00	(0.93,1.08)
Working PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.94	(0.86,1.04)	0.95	(0.86,1.04)	0.95	(0.86,1.04)	0.95	(0.86,1.04)
Domestic and gardening PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	1.01	(0.94,1.08)	1.01	(0.94,1.08)	1.01	(0.94,1.08)	1.01	(0.94,1.08)
Transport related PA MET mins/week								
Inactivity	ref.		ref.		ref.		ref.	
Any activity	0.99	(0.91,1.08)	0.99	(0.91,1.08)	0.99	(0.91,1.08)	0.99	(0.91,1.08)
BMI								
Normal	ref.		ref.		ref.		ref.	
Overweight	1.06	(0.92,1.21)	1.06	(0.92,1.21)	1.05	(0.92,1.21)	1.05	(0.92,1.21)
Obese	0.99	(0.84,1.15)	0.99	(0.84,1.15)	0.98	(0.84,1.14)	0.99	(0.85,1.16)
Pedometer steps per day								
Sedentary lifestyle	0.85	(0.68,1.06)	0.85	(0.68,1.06)	0.85	(0.68,1.06)	0.85	(0.68,1.07)
Low active	1.02	(0.89,1.18)	1.02	(0.89,1.18)	1.03	(0.89,1.18)	1.03	(0.89,1.18)
Somewhat active	ref.		ref.		ref.		ref.	
Active	0.97	(0.82,1.15)	0.97	(0.82,1.15)	0.97	(0.82,1.15)	0.97	(0.82,1.15)
High active	0.83	(0.64,1.07)	0.83	(0.64,1.07)	0.83	(0.64,1.08)	0.83	(0.64,1.07)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; DGPA: domestic and gardening physical activity; All bolded values are p<0.05; Model 1: adjusted Model adjusted for age, life events, personality and education; Mode 2: Model 1+ occupation; Model 3: Model 1+ work schedule; Model 4: Model 1+ working hours; Personality included agreeableness and extroversion; *among those participants did any activity; The number of participants ranges from n=336 to n=832

4.4 Discussion

Higher job stress was associated with co-occurrence of health risk behaviours and some individual health risk behaviours such as unhealthy diet, less minutes of LTPA, more sitting time during the weekend, being a current smoker and higher alcohol consumption, which are consistent with previous studies [34, 42, 43]. This study adds to the existing literature because it focuses on a younger group of individuals in Australia, for whom studies are lacking. Previous analyses had also failed to account for some potentially important confounding factors including life events and personality, however, the associations remained even after adjusting for these. These findings are potentially important for understanding how job stress leads to poorer health outcomes, as discussed below.

The results of this study suggest that a higher ERI, namely higher job stress, was associated with a lower Healthy Lifestyle Score, which means greater co-occurrence of health risk behaviours. This association could be found in both continuous (range from 0 to 10 health behaviours) and categorical healthy lifestyle score (high scores, namely more than 7 health behaviours). The healthy lifestyle score used in this study not only included those conventional risk behaviours (smoking, alcohol, overweight and physical inactivity), but also added items about diet [19] which have not previously been considered by other studies on job stress and co-occurring health risk behaviours [42, 43]. In the present study, higher scores on the reward scale were positively associated with higher probability of high healthy lifestyle scores, while there was no association between the effort scale and healthy lifestyle score. Other researchers have suggested that one possible explanation linking job stress and selected health risk behaviours is to relieve the stress from work [42]. According to the self-medication theory, people with higher levels of stress engage in some risk behaviours to relieve the unfavourable symptoms associated with the stressor. For example, they might use tobacco, consume ‘comfort

foods' or drink alcohol to diminish stress from work [123-127]. Engaging in these behaviours might make people feel less stress in the moment, but they are also associated with higher risk of chronic diseases (e.g. cardiovascular diseases). For example, the INTERSTROKE case-control study by O'Donnell and colleagues suggested that the population attributable risks (PAR) of stroke for "health-related behaviours" ranged from 4% to 29%. This means that 4 to 29% of all stroke incidences can be attributed to health risk behaviours, for example, smoking (18.9%), physical inactivity (28.5%), alcohol consumption(3.8%), waist to hip ratio (26.5%) and poor diet (18.8%) around the world [128]. Yusuf *et al.* also identified similar findings in the INTERHEART study as previously discussed [40]. As mentioned earlier, the risk of mortality might be higher when health risk behaviours are accumulated, such as obtaining a low score on the Healthy Lifestyle Score in this study. In a 24-year follow-up study based on 77,782 US women, van Dam *et al.* indicated that combined health risk behaviours, including smoking, overweight, physical inactivity, alcohol consumption and low diet quality score, were associated with 51% population attributable risks (PAR) of all-cause mortality in younger women (aged <60 years), while the PAR of all-cause mortality for individual lifestyle risk ranged from 7% to 28%, such as smoking (28%), being overweight (14%), physical inactivity (17%), unhealthy diet (13%) and heavy drinking (7%) [41]. Kivimaki *et al.* suggested, based on the findings in the IDP-Work Consortium, that the PAR of coronary heart disease for job stress was 3.4% [129] with health risk behaviours, including smoking, physical inactivity, heavy drinking and obesity and these risk behaviours might contribute to about 50% of the adverse effect of job stress on coronary artery disease (CAD) by being possible mediators between job stress and CAD [130]. However, in previous studies by the IPD-Work Consortium, little was known about the link between work-related psychosocial factors and health risk behaviours in the ERI model [32]. Thus, the results of the link between the ERI and co-

occurrence of health risk behaviours provide new evidence to advance research on job stress and health-related behaviours.

This study is the first to examine in detail the associations between diet and job stress. Several measures like the dietary guideline index (DGI), extra foods consumption and frequency of take away food consumption were used as measurements of dietary quality. The DGI score measured in this study reflects consumption of 5 core food groups, such as fruits, vegetables, cereals, meat and alternatives and dairy [131]. Consumption of "extra foods", referring to foods that are not essential to provide nutrients and contain too much fat, sugar and salt, including foods such as soft drinks chocolate, pizza and all alcoholic beverages were also tested [131]. A negative association was found between ERI and DGI, meaning the higher ERI, the lower DGI (higher scores mean better diet), whereas a positive association was found between the ERI and serves of extra foods in present study. Thus, the data supported the idea that high levels of job stress are associated with low levels of healthy food and high intake of "extra foods" like soft drinks and chocolate. These findings can be compared to studies of general stress, but not job stress given the lack of studies. For example, a longitudinal study by the Midlife in the US II (MIDUS II) group found evidence for an association between stress and food consumption, thus, supporting these findings [132]. The MIDUS II group looked at 1,138 participants in the US and suggested that people with higher stress consumed high volumes of energy-dense comfort foods, with these foods being associated with worse glycaemic control and diabetic morbidities [132]. Explanatory factors for people wanting to consume "comfort foods", when being stressed, have been examined in experimental studies. These studies found support of a craving for fat, sugar and energy in stressed situations by showing that parts of the brain, which control mood, like the meso-limbic dopaminergic brain "reward" system, are affected by eating foods high in fat, sugar, and energy [125]. This might be one explanation

why people with higher job stress in this study were found to be eating more extra foods, like "comfort food", as it reduces their negative emotional responses to stress at work.

Also related to diet, women with higher ERI had a higher probability of eating takeaway food twice or more times per week. An explanation for this might be time constraints associated with high stress jobs with long working hours, women are more likely to have more work to do at home as well [17], and take away food might save time on cooking [17, 133]. However, adjusting for working hours in the models did not change these associations ruling out long working hours as an explanatory mechanism for frequent consumption of takeaway food. Given that takeaway foods have a similar energy content to 'comfort foods' in the experimental studies discussed above, some of the association between frequency of takeaway foods and job stress could be explained by the foods' positive effects on mood regulation and might be related to the 'self-medication' hypothesis discussed above. However, the food consumption pattern places one's health at risk. The findings of a previous study on the CDAH cohort found that consuming takeaway food more than twice a week was associated with poorer diet quality and higher prevalence of moderate abdominal obesity which are risk factors for a number of diseases, e.g. cardiovascular diseases and diabetes [92]. Workplace interventions are available to break this vicious cycle. A meta-analysis of randomized controlled workplace interventions by Montano, Hoven and Siegrist found that workplace interventions might result in favourable health outcomes, such as decreased BMI and increased daily consumption of fruit and vegetables [134]. Combining these results, the current study suggests that reducing job stress might be beneficial in improving workers' diet quality and thereby workforce well-being, if these associations are causal.

This study extends upon the known negative association between job stress measured with the ERI and physical activity, meaning the higher level of job stress, the lower levels of physical

activity in leisure time, by testing different domains of physical activity, sitting time and pedometer measurement of steps. These findings suggest that higher job stress (ERI) are related to lower levels of physical activity in leisure time and more time spent sitting during the weekend and, furthermore, that this association is independent of SEP, work factors, personality and life events. The negative association between job stress and less physical activity in leisure time (ERI and LTPA) is consistent with findings from a previous study [34] and the explanatory mechanism behind this might be that higher job stress is related to excessive fatigue and a higher need for rest as indicated by more sitting time during the weekends [135]. For women, higher job stress (ERI) was associated with more pedometer steps per day. In addition to this, higher job stress (ERI) was associated with a tendency toward less physical activity in leisure time (LTPA), however, this is greatly influenced by working hours and job schedule. The association between ERI and greater work physical activity, more pedometer measurement of steps per day and less minutes of transport related physical activity, is perhaps not surprising given that the effort scale includes participants' self-reporting of whether they feel pressured to work overtime or whether they have a heavy workload. People with physically demanding jobs might be too tired to do physical activity in the time away from work (e.g. leisure time or time of transport) and choose to rest during the weekends, as indicated by total minutes of weekend sitting [135]. These results suggest that reducing job stress might be beneficial in improving workers' physical activity, which might be one way to improve workers' physical health. Findings from a randomised control trial in women is in support of this, with results which showed that work ability was increased after 6-months of physical activity intervention [136]. Additionally, the favourable effects of workplace physical activity promotions on physical fitness and diabetes risk are presented in a systematic review [137]. Thus, work ability, physical fitness and health are likely to be improved by physical activity promotions in the working environment. Meanwhile, the physical activity promotion can react

on job stress. A meta-analysis based on studies from 1969 through 2007 showed that workplace physical activity preventions may be beneficial in reducing job stress [138].

There was no association between ERI and both continuous (data was not presented) and categorical BMI in either gender in this study. This may not rule out any association, as it may be non-linear. Some studies have reported that the relationship between job stress and BMI is "U" shaped [139]. In this study, those overweight workers were more likely to gain weight, while lean workers were more likely to lose weight when suffering job stress [42]. Approximately 1% participants (1% men and 2% women) had a BMI<18.5 kg/m^2 (underweight) and about 5% participants (3% men and 6% women) had a BMI>35 kg/m^2 (class II obesity) (data was not presented) [139]. The ERI in this current cohort were mostly less than 1, meaning that most participants in the present study had lower job stress, and only 1.6% of the participants had a ERI higher than this cut-off point [140]. Considering the distribution of ERI and BMI in this cohort converged on the bottom of the "U" shape, the results showing no association between ERI and BMI seem credible. These results are in agreement with previous studies, which had not found any association between job stress and BMI [12, 141], though few participants were overweight in this study (53% of men and 42% of women) compared to people of the same age in the general population in Australia (74% of men and 55% of women) [142]. Therefore, the association between ERI and BMI was possibly underestimated

A great strength of the present study is the control for a wide range of potential confounders, including life events and personality, which have not been captured in many other studies. The findings show that adjusting for major life events and personality slightly weakened the association between higher ERI and some unhealthy behaviours (i.e., lower healthy lifestyle score and lower DGI in men). Thus, major life events and some personality traits may make people more susceptible to suffer from the negative effects of job stress (e.g., healthy risk

behaviours). Adverse life events increase the risk of poorer mental health, which could impact on how job stress is perceived, meaning lower absolute levels of work are considered stressful [143]. In this cohort, people with higher ERI also had a greater number of major life events within the past 5 years. Other studies have also found adverse life events to be associated with worse health behaviours, such as higher risk of alcohol consumption [119] and lower physical activity [144], which is why life events were considered as a potential confounder. In the CDAH study, personality was measured by the NEO Five Factor Personality Inventory that includes agreeableness, extroversion, neuroticism, openness and conscientiousness. According to the standard criteria for confounding factors described under 'data analysis', only agreeableness and extroversion appeared to be confounders of the associations between job stress and health behaviours. Extroversion has been shown by others to have a positive association with coping ability [145], and agreeableness has been found to be positively associated with job satisfaction and performance [146] which could alleviate the adverse effect of job stress. However, most results in the present study suggested that job stress directly had an unfavourable effect on health risk behaviours independent of personality and adverse life events.

The effect size of the association between ERI and physical activity (including leisure time physical activity work related physical activity and total sitting time on weekdays), changed dramatically after adjusting for socioeconomic and work-related covariates. It was possible that models were over adjusted for work characteristics that might decrease precision when examining the association between job stress and health behaviours, which was also mentioned in another study [43]. To examine this, a sensitivity analysis was conducted to examine the effect of each individual socioeconomic and work-related covariate. The results of these analyses shows that working hours had an effect on the association between job stress and physical activity. There are many potential explanations for the close association between long

working hours and job stress, for example, long hours at work means less time with the family, thus increasing job stress by increasing the risk of work-life conflicts [147]. A recent commentary on IPD-Work Consortium papers by Kivimai *et al.* pointed out that researchers of the IPD-Work Consortium planned to examine the role of long working hours in the association between job stress and lifestyle risk behaviours [32]. The findings of the effect of working hours on the link between job stress and physical activity supports this.

In this study, both continuous and categorized variable were used to explore the association between job stress and health risk behaviours. Although the results for some variables were not statistically significant for both continuous and categorical versions of variables, the results of the different analysis showed similar findings. For example, in men, higher ERI was associated with less minutes of LTPA when used LTPA as continuous variable and this association remained statistically significant after adjusting for other factors. Although the negative association between ERI and LTPA was not statistically significant when used LTPA as categorical variable, these results also showed that those men with higher ERI were less likely to do any physical activity in their leisure time. In women, both higher ERI and higher effort were associated with less minutes of transport related physical activity when used minutes of transport related physical activity as continuous variable. Although the negative association between ERI, effort and transport related physical activity were not statistically significant when used transport related physical activity as categorical variable, these results also showed that those women with higher ERI were less likely to do any transport related physical activity. In general, the continuous and categorical exposure variables in this study showed consistent findings.

There are some limitations of this study. First, this study is cross-sectional and therefore makes it impossible to draw any conclusions about causality. Second, the use of self-reported measures may contribute to inaccuracy in the assessment of health risk behaviours, however,

all measures used have previously been validated. Third, although this study was a national study, the sample was not fully representative of the working population, therefore this may limit the extent to which these findings can be generalised to the rest of the Australian working population. Finally, as discussed before, the range of scores on the ERI was lower than reported in other studies of the working population, questioning whether these findings are transferable to other contexts. Further discussion of the limitations is given in Chapter 5.

Despite the above-mentioned limitations, the present study also has several strengths. The study aimed to add to prior research in several ways. First, this is the first study to examine the standard ERI model in relation to co-occurrence of personal health risk behaviours. Second, most previous studies have evaluated co-occurring health risk behaviours without considering diet. To improve the understanding of the association between job stress and health risk behaviours and to make the findings easier to apply in workplace health promotions, the 10 item healthy life score (includes diet habit items) was used in this study. Third, common confounders were controlled for, such as age, SEP, working hours, working schedule, but also for life events and personality, the latter not being measured and controlled for in previous studies. Finally, the present study focuses on a national cohort of Australians, whereas most previous studies have been focused on Europeans. Thus, the findings enhance research on job stress and health behaviours with high validity and usefulness in the Australian working population.

In conclusion, ERI and health risk behaviours were associated, and these associations were independent of socio-economic position, work-related factors, life events and personality. This provides evidence for a potential direct link between job stress and health risk behaviours and is in support of theories linking job stress and health outcomes via health risk behaviours. For the future, understanding which types of interventions are effective in reducing job stress and improving healthy lifestyles, will be crucial in maintaining a healthy workforce.

Appendix

Table 44 Adjusted regression models of ERI and each healthy lifestyle score items

	Change in outcome per 0.1 unit change in ERI							
	Unadjusted		model adjusted for age		model adjusted for age and individual SEP factors		model adjusted for age, individual SEP factors and life events	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Men(n=486)								
Non-smoker	0.99	(0.94,1.05)	0.99	(0.94,1.05)	0.99	(0.94,1.05)	1.00	(0.95,1.05)
BMI<25	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.01	(0.93,1.09)
LTPA>3hrs/week	1.01	(0.96,1.06)	1.01	(0.96,1.06)	1.01	(0.95,1.06)	1.01	(0.95,1.06)
Alcohol<20g/day	1.00	(0.95,1.06)	1.00	(0.95,1.06)	1.01	(0.96,1.06)	1.01	(0.96,1.06)
Low salt use	0.99	(0.91,1.09)	1.00	(0.91,1.09)	0.99	(0.91,1.09)	1.01	(0.92,1.11)
Uses skim milk	0.94	(0.89,1.00)	0.95	(0.89,1.00)	0.94	(0.89,1.00)	0.95	(0.89,1.01)
Fish≥2 times/week	0.99	(0.94,1.05)	0.99	(0.94,1.05)	1.00	(0.94,1.06)	0.99	(0.94,1.05)
Meat<5 times/week	**0.82**	**(0.70,0.95)**	**0.82**	**(0.70,0.95)**	**0.80**	**(0.68,0.94)**	**0.81**	**(0.69,0.95)**
Fruit/veg.≥7 times/week	0.88	(0.73,1.07)	0.88	(0.73,1.07)	0.89	(0.73,1.08)	0.89	(0.73,1.09)
Uses low fat spread	0.98	(0.95,1.01)	0.98	(0.95,1.01)	0.98	(0.95,1.01)	0.98	(0.96,1.01)
Women(n=696)								
Non-smoker	0.97	(0.92,1.02)	0.97	(0.92,1.02)	0.97	(0.92,1.03)	0.98	(0.92,1.03)
BMI<25	0.99	(0.94,1.06)	0.99	(0.94,1.06)	0.98	(0.91,1.05)	0.98	(0.92,1.05)
LTPA>3hrs/week	1.01	(0.96,1.06)	1.01	(0.96,1.06)	1.01	(0.96,1.07)	1.01	(0.96,1.07)
Alcohol<20g/day	1.00	(0.95,1.05)	1.00	(0.95,1.05)	1.00	(0.95,1.05)	1.00	(0.95,1.05)
Low salt use	0.97	(0.90,1.06)	0.97	(0.90,1.06)	1.00	(0.92,1.09)	1.00	(0.92,1.09)
Uses skim milk	1.02	(0.96,1.08)	1.02	(0.96,1.08)	1.02	(0.96,1.09)	1.03	(0.96,1.09)
Fish≥2 times/week	0.97	(0.95,1.00)	0.98	(0.95,1.01)	0.97	(0.93,1.00)	0.97	(0.93,1.00)
Meat<5 times/week	0.97	(0.89,1.06)	0.97	(0.89,1.06)	0.94	(0.85,1.03)	0.93	(0.84,1.03)
Fruit/veg.≥7 times/week	1.00	(0.88,1.13)	1.00	(0.88,1.13)	0.94	(0.82,1.09)	0.94	(0.81,1.09)
Uses low fat spread	0.98	(0.93,1.04)	0.98	(0.93,1.04)	0.99	(0.93,1.05)	0.99	(0.93,1.05)

CI: confidence interval; LTPA: leisure time physical activity;All bolded values are p<0.05;SEP factors included education and occupation level, working hours and work schedule;Individual factors included life events and personality (agreeableness and extroversion)

Table 45 Adjusted regression models of effort and each healthy lifestyle score items

	Change in outcome per 5 units change in effort							
	Unadjusted		model adjusted for age		model adjusted for age and individual SEP factors		model adjusted for age, individual SEP factors and life events	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Men(n=486)								
Non-smoker	0.99	(0.86,1.14)	0.99	(0.86,1.14)	1.00	(0.86,1.15)	1.01	(0.87,1.17)
BMI<25	0.95	(0.77,1.18)	0.95	(0.77,1.18)	0.93	(0.74,1.17)	0.96	(0.76,1.20)
LTPA>3hrs/week	1.03	(0.89,1.18)	1.03	(0.89,1.18)	1.04	(0.89,1.20)	1.03	(0.89,1.20)
Alcohol<20g/day	1.00	(0.87,1.15)	1.00	(0.87,1.15)	1.01	(0.87,1.16)	1.01	(0.87,1.17)
Low salt use	1.02	(0.81,1.30)	1.03	(0.81,1.31)	1.02	(0.80,1.32)	1.07	(0.83,1.39)
Uses skim milk	0.93	(0.81,1.06)	0.93	(0.81,1.06)	0.91	(0.79,1.05)	0.93	(0.81,1.08)
Fish≥2 times/week	1.01	(0.87,1.17)	1.01	(0.87,1.17)	1.02	(0.88,1.20)	1.02	(0.87,1.19)
Meat<5 times/week	**0.67**	**(0.48,0.93)**	**0.66**	**(0.48,0.93)**	**0.64**	**(0.45,0.91)**	**0.66**	**(0.46,0.94)**
Fruit/veg.≥7 times/week	0.78	(0.50,1.24)	0.79	(0.50,1.24)	0.80	(0.50,1.29)	0.82	(0.51,1.33)
Uses low fat spread	0.97	(0.83,1.13)	0.97	(0.83,1.13)	0.97	(0.83,1.14)	0.98	(0.83,1.15)
Women(n=696)								
Non-smoker	0.95	(0.85,1.07)	0.95	(0.85,1.07)	0.95	(0.84,1.08)	0.96	(0.84,1.09)
BMI<25	1.00	(0.87,1.15)	1.00	(0.87,1.15)	0.96	(0.82,1.12)	0.96	(0.82,1.12)
LTPA>3hrs/week	1.03	(0.92,1.15)	1.03	(0.92,1.15)	1.03	(0.91,1.17)	1.03	(0.91,1.17)
Alcohol<20g/day	1.00	(0.90,1.11)	1.00	(0.90,1.11)	1.00	(0.89,1.12)	1.00	(0.89,1.12)
Low salt use	0.88	(0.74,1.06)	0.88	(0.74,1.06)	0.93	(0.76,1.13)	0.94	(0.77,1.14)
Uses skim milk	1.06	(0.98,1.14)	1.06	(0.98,1.14)	1.07	(0.99,1.16)	1.07	(0.99,1.16)
Fish≥2 times/week	0.97	(0.91,1.03)	0.97	(0.91,1.03)	0.95	(0.88,1.02)	0.95	(0.88,1.02)
Meat<5 times/week	0.93	(0.77,1.12)	0.92	(0.76,1.12)	0.84	(0.67,1.04)	0.83	(0.66,1.03)
Fruit/veg.≥7 times/week	1.01	(0.76,1.35)	1.01	(0.76,1.34)	0.87	(0.63,1.22)	0.86	(0.62,1.19)
Uses low fat spread	0.95	(0.88,1.02)	0.94	(0.87,1.01)	0.95	(0.88,1.03)	0.96	(0.89,1.04)

CI: confidence interval; LTPA: leisure time physical activity; All bolded values are p<0.05; SEP factors included education and occupation level, working hours and work schedule; Individual factors included life events and personality (agreeableness and extroversion)

Table 46 Adjusted regression models of reward and each healthy lifestyle score items

	Change in outcome per 5 units change in reward							
	Unadjusted		model adjusted for age		model adjusted for age and individual SEP factors		model adjusted for age, individual SEP factors and life events	
Outcome	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Men(n=486)								
Non-smoker	1.02	(0.94,1.11)	1.02	(0.94,1.11)	1.02	(0.94,1.11)	1.01	(0.93,1.11)
BMI<25	0.96	(0.85,1.09)	0.95	(0.85,1.07)	0.94	(0.84,1.06)	0.93	(0.82,1.05)
LTPA>3hrs/week	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.00	(0.92,1.09)	1.00	(0.92,1.09)
Alcohol<20g/day	1.00	(0.92,1.09)	1.00	(0.92,1.09)	1.00	(0.92,1.08)	0.99	(0.91,1.08)
Low salt use	1.02	(0.89,1.17)	1.02	(0.89,1.18)	1.02	(0.88,1.17)	0.99	(0.86,1.14)
Uses skim milk	**1.17**	**(1.06,1.29)**	**1.16**	**(1.05,1.28)**	**1.16**	**(1.04,1.28)**	**1.14**	**(1.03,1.26)**
Fish≥2 times/week	1.01	(0.92,1.10)	1.01	(0.92,1.10)	1.01	(0.92,1.10)	1.01	(0.92,1.11)
Meat<5 times/week	**1.26**	**(1.02,1.56)**	**1.26**	**(1.02,1.55)**	**1.28**	**(1.03,1.58)**	**1.25**	**(1.01,1.55)**
Fruit/veg.≥7 times/week	1.13	(0.86,1.48)	1.13	(0.86,1.49)	1.13	(0.86,1.48)	1.13	(0.85,1.50)
Uses low fat spread	1.05	(0.99,1.10)	1.04	(0.99,1.10)	1.04	(0.99,1.10)	1.04	(0.99,1.10)
Women(n=696)								
Non-smoker	1.03	(0.95,1.11)	1.03	(0.95,1.11)	1.02	(0.95,1.10)	1.02	(0.94,1.10)
BMI<25	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.00	(0.91,1.10)
LTPA>3hrs/week	1.00	(0.93,1.08)	1.00	(0.93,1.08)	1.01	(0.93,1.09)	1.00	(0.92,1.08)
Alcohol<20g/day	1.01	(0.94,1.08)	1.01	(0.94,1.08)	1.00	(0.93,1.08)	1.00	(0.93,1.08)
Low salt use	0.98	(0.87,1.10)	0.98	(0.87,1.10)	0.97	(0.86,1.09)	0.96	(0.85,1.09)
Uses skim milk	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.02	(0.93,1.12)	1.01	(0.92,1.11)
Fish≥2 times/week	**1.07**	**(1.01,1.12)**	**1.06**	**(1.01,1.11)**	**1.06**	**(1.01,1.11)**	**1.05**	**(1.00,1.11)**
Meat<5 times/week	0.98	(0.87,1.11)	0.98	(0.87,1.10)	0.99	(0.88,1.12)	1.01	(0.89,1.14)
Fruit/veg.≥7 times/week	0.99	(0.82,1.20)	0.98	(0.81,1.19)	0.99	(0.82,1.21)	0.98	(0.81,1.19)
Uses low fat spread	0.99	(0.91,1.07)	0.98	(0.91,1.07)	0.98	(0.90,1.07)	0.98	(0.90,1.06)

CI: confidence interval; LTPA: leisure time physical activity;
All bolded values are p<0.05;
SEP factors included education and occupation level, working hours and work schedule;
Individual factors included life events and personality (agreeableness and extroversion)

Table 47 Adjusted SEP models of the association between ERI and each healthy lifestyle score items

Outcome	Change in outcome per 0.1 unit change in ERI							
	Model adjusted for age, life events, personality and education		Model adjusted for age, life events, personality, education and occupation		Model adjusted for age, life events, personality, education and work schedule		Model adjusted for age, life events, personality, education and working hours	
	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men(n=486)								
Non-smoker	1.00	(0.95,1.05)	1.00	(0.94,1.05)	1.00	(0.95,1.05)	1.00	(0.95,1.06)
BMI<25	1.01	(0.93,1.09)	1.01	(0.93,1.09)	1.01	(0.93,1.09)	1.00	(0.93,1.09)
LTPA>3hrs/week	1.00	(0.95,1.06)	1.00	(0.95,1.06)	1.00	(0.95,1.06)	1.01	(0.95,1.06)
Alcohol<20g/day	1.01	(0.96,1.06)	1.01	(0.96,1.06)	1.00	(0.95,1.06)	1.01	(0.96,1.06)
Low salt use	1.01	(0.93,1.10)	1.02	(0.93,1.11)	1.01	(0.92,1.10)	1.01	(0.92,1.10)
Uses skim milk	0.95	(0.90,1.01)	0.95	(0.90,1.01)	0.95	(0.90,1.01)	0.95	(0.90,1.01)
Fish≥2 times/week	0.99	(0.93,1.05)	0.99	(0.93,1.05)	0.99	(0.93,1.05)	0.99	(0.94,1.05)
Meat<5 times/week	**0.82**	**(0.70,0.95)**	**0.81**	**(0.70,0.95)**	**0.81**	**(0.69,0.95)**	**0.81**	**(0.69,0.95)**
Fruit/veg.≥7 times/week	0.88	(0.72,1.08)	0.88	(0.72,1.07)	0.88	(0.72,1.08)	0.89	(0.73,1.10)
Uses low fat spread	0.98	(0.96,1.01)	0.98	(0.96,1.01)	0.98	(0.96,1.01)	0.98	(0.96,1.01)
Women(n=696)								
Non-smoker	0.97	(0.92,1.03)	0.97	(0.92,1.02)	0.97	(0.92,1.03)	0.98	(0.93,1.03)
BMI<25	0.99	(0.93,1.05)	0.99	(0.92,1.05)	0.99	(0.93,1.05)	0.98	(0.92,1.05)
LTPA>3hrs/week	1.02	(0.97,1.07)	1.02	(0.96,1.07)	1.02	(0.97,1.07)	1.01	(0.96,1.07)
Alcohol<20g/day	1.00	(0.95,1.05)	1.00	(0.95,1.05)	1.00	(0.95,1.05)	1.00	(0.95,1.05)
Low salt use	0.99	(0.91,1.07)	0.99	(0.91,1.07)	0.99	(0.91,1.07)	1.00	(0.92,1.09)
Uses skim milk	1.02	(0.97,1.09)	1.02	(0.96,1.09)	1.02	(0.97,1.09)	1.03	(0.97,1.09)
Fish≥2 times/week	0.97	(0.92,1.03)	0.97	(0.91,1.03)	0.97	(0.92,1.03)	0.97	(0.91,1.03)
Meat<5 times/week	0.95	(0.86,1.04)	0.95	(0.87,1.04)	0.95	(0.86,1.04)	0.93	(0.84,1.03)
Fruit/veg.≥7 times/week	0.99	(0.87,1.12)	0.97	(0.85,1.11)	0.99	(0.87,1.12)	0.96	(0.83,1.11)
Uses low fat spread	0.99	(0.93,1.05)	0.99	(0.93,1.05)	0.99	(0.93,1.05)	0.99	(0.93,1.05)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; All bolded values are p<0.05;
Personality included agreeableness and extroversion

Table 48 Adjusted SEP models of the association between effort and each healthy lifestyle score items

	Change in outcome per 5 units change in effort							
	Model adjusted for age, life events, personality and education		Model adjusted for age, life events, personality, education and occupation		Model adjusted for age, life events, personality, education and work schedule		Model adjusted for age, life events, personality, education and working hours	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men(n=486)								
Non-smoker	1.00	(0.86,1.15)	1.00	(0.86,1.15)	1.00	(0.86,1.15)	1.01	(0.87,1.17)
BMI<25	0.97	(0.78,1.21)	0.97	(0.78,1.21)	0.97	(0.78,1.21)	0.96	(0.76,1.20)
LTPA>3hrs/week	1.02	(0.88,1.18)	1.02	(0.88,1.18)	1.02	(0.88,1.18)	1.03	(0.89,1.20)
Alcohol<20g/day	1.01	(0.87,1.16)	1.01	(0.87,1.16)	1.00	(0.87,1.16)	1.02	(0.88,1.18)
Low salt use	1.08	(0.84,1.37)	1.08	(0.84,1.39)	1.08	(0.84,1.38)	1.07	(0.83,1.37)
Uses skim milk	0.94	(0.82,1.08)	0.94	(0.82,1.08)	0.93	(0.81,1.07)	0.94	(0.82,1.08)
Fish≥2 times/week	1.00	(0.86,1.17)	1.00	(0.86,1.17)	1.00	(0.86,1.17)	1.02	(0.87,1.19)
Meat<5 times/week	**0.66**	**(0.47,0.93)**	**0.66**	**(0.47,0.93)**	**0.66**	**(0.47,0.92)**	**0.66**	**(0.46,0.93)**
Fruit/veg.≥7 times/week	0.80	(0.50,1.27)	0.79	(0.50,1.27)	0.79	(0.50,1.26)	0.83	(0.51,1.34)
Uses low fat spread	0.97	(0.83,1.13)	0.97	(0.83,1.13)	0.97	(0.83,1.13)	0.98	(0.83,1.15)
Women(n=696)								
Non-smoker	0.95	(0.85,1.07)	0.95	(0.84,1.06)	0.95	(0.85,1.07)	0.96	(0.85,1.09)
BMI<25	0.98	(0.85,1.13)	0.97	(0.84,1.12)	0.98	(0.85,1.13)	0.97	(0.83,1.12)
LTPA>3hrs/week	1.04	(0.92,1.16)	1.04	(0.92,1.16)	1.04	(0.92,1.16)	1.03	(0.91,1.17)
Alcohol<20g/day	1.00	(0.89,1.11)	1.00	(0.89,1.11)	1.00	(0.89,1.11)	1.00	(0.89,1.12)
Low salt use	0.91	(0.75,1.09)	0.91	(0.75,1.09)	0.91	(0.75,1.09)	0.93	(0.77,1.14)
Uses skim milk	1.07	(0.94,1.23)	1.07	(0.93,1.22)	1.07	(0.94,1.23)	1.08	(0.94,1.25)
Fish≥2 times/week	0.96	(0.84,1.09)	0.95	(0.84,1.08)	0.96	(0.84,1.09)	0.95	(0.82,1.08)
Meat<5 times/week	0.87	(0.71,1.06)	0.87	(0.71,1.07)	0.87	(0.71,1.06)	0.83	(0.66,1.03)
Fruit/veg.≥7 times/week	0.98	(0.73,1.31)	0.94	(0.70,1.26)	0.98	(0.74,1.31)	0.91	(0.66,1.25)
Uses low fat spread	0.96	(0.84,1.09)	0.96	(0.84,1.09)	0.96	(0.84,1.09)	0.96	(0.83,1.10)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; All bolded values are p<0.05;
Personality included agreeableness and extroversion

Table 49 Adjusted SEP models of the association between reward and each healthy lifestyle score items

	Change in outcome per 5 units change in reward							
	Model adjusted for age, life events, personality and education		Model adjusted for age, life events, personality, education and occupation		Model adjusted for age, life events, personality, education and work schedule		Model adjusted for age, life events, personality, education and working hours	
Outcome	β	95%CI	β	95%CI	β	95%CI	β	95%CI
Men(n=486)								
Non-smoker	1.01	(0.93,1.10)	1.02	(0.93,1.11)	1.01	(0.93,1.10)	1.01	(0.93,1.10)
BMI<25	0.94	(0.84,1.06)	0.93	(0.83,1.05)	0.94	(0.84,1.06)	0.94	(0.84,1.06)
LTPA>3hrs/week	1.00	(0.92,1.09)	1.00	(0.92,1.09)	1.00	(0.91,1.09)	1.00	(0.91,1.08)
Alcohol<20g/day	1.00	(0.92,1.09)	1.00	(0.92,1.09)	1.00	(0.92,1.08)	1.00	(0.92,1.08)
Low salt use	1.00	(0.87,1.15)	0.99	(0.86,1.14)	1.00	(0.87,1.15)	1.00	(0.87,1.15)
Uses skim milk	**1.14**	**(1.04,1.26)**	**1.14**	**(1.03,1.26)**	**1.14**	**(1.04,1.26)**	**1.15**	**(1.04,1.27)**
Fish≥2 times/week	1.02	(0.93,1.12)	1.01	(0.92,1.11)	1.02	(0.93,1.12)	1.01	(0.92,1.11)
Meat<5 times/week	1.23	(1.00,1.51)	**1.24**	**(1.01,1.53)**	**1.25**	**(1.01,1.54)**	1.23	(0.99,1.51)
Fruit/veg.≥7 times/week	1.14	(0.86,1.50)	1.15	(0.86,1.52)	1.14	(0.86,1.50)	1.12	(0.85,1.48)
Uses low fat spread	1.04	(0.95,1.15)	1.05	(0.95,1.15)	1.04	(0.95,1.15)	1.04	(0.95,1.15)
Women(n=696)								
Non-smoker	1.02	(0.95,1.11)	1.02	(0.95,1.11)	1.02	(0.94,1.10)	1.02	(0.95,1.11)
BMI<25	1.01	(0.91,1.11)	1.00	(0.91,1.11)	1.00	(0.91,1.11)	1.00	(0.91,1.11)
LTPA>3hrs/week	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.00	(0.92,1.08)	1.00	(0.92,1.08)
Alcohol<20g/day	1.00	(0.93,1.08)	1.00	(0.93,1.08)	1.00	(0.93,1.08)	1.00	(0.93,1.08)
Low salt use	0.96	(0.86,1.08)	0.96	(0.86,1.08)	0.96	(0.86,1.09)	0.96	(0.85,1.08)
Uses skim milk	1.02	(0.92,1.11)	1.01	(0.92,1.11)	1.02	(0.93,1.12)	1.01	(0.92,1.11)
Fish≥2 times/week	**1.06**	**(1.01,1.11)**	**1.06**	**(1.01,1.11)**	1.05	(1.00,1.10)	**1.06**	**(1.01,1.11)**
Meat<5 times/week	1.00	(0.88,1.12)	1.00	(0.88,1.12)	1.00	(0.89,1.13)	1.00	(0.88,1.12)
Fruit/veg.≥7 times/week	0.97	(0.80,1.18)	0.96	(0.80,1.16)	0.99	(0.81,1.20)	0.97	(0.80,1.18)
Uses low fat spread	0.98	(0.90,1.06)	0.98	(0.90,1.06)	0.97	(0.90,1.06)	0.98	(0.90,1.06)

CI: confidence interval; DGI: Diet Quality Index; LTPA: leisure time physical activity; All bolded values are p<0.05;Personality included agreeableness and extroversion

The association between effort, reward and ERI and age

There was no association between ERI, effort and reward and age in both genders (*Figure 8*).

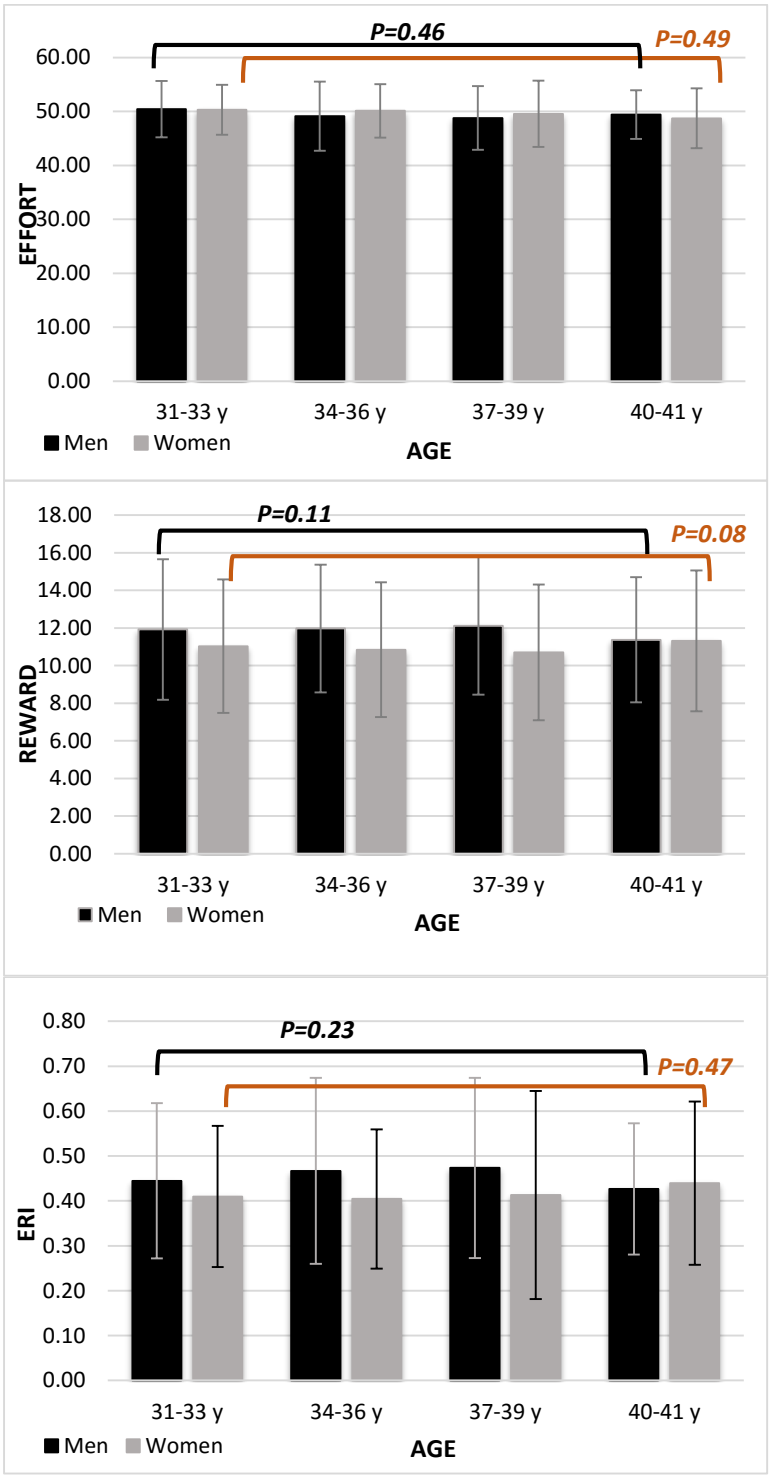
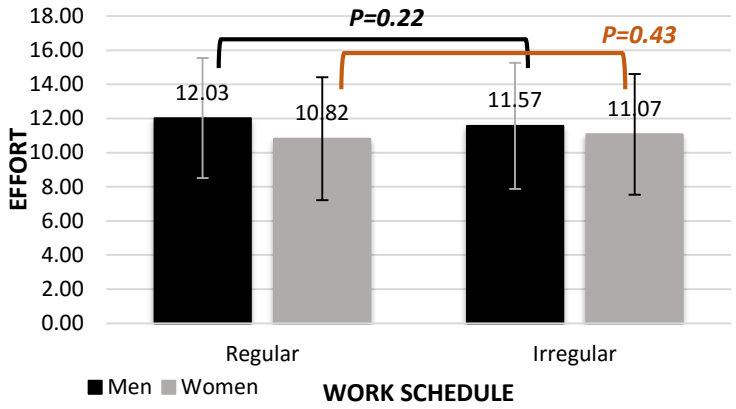


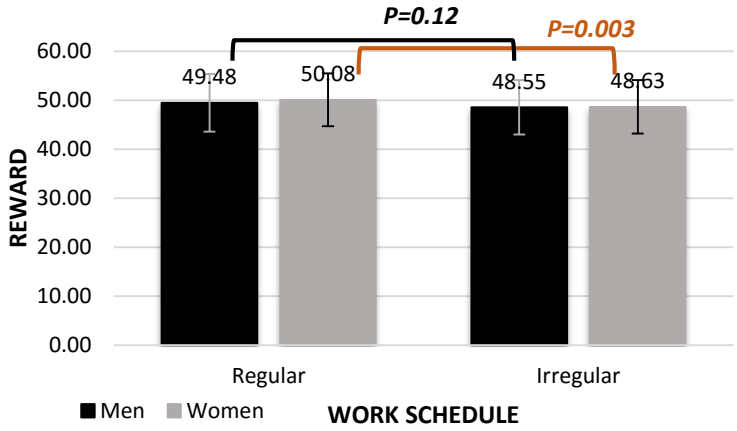
Figure 8 Association between effort (a), reward (b) and ERI ratio(c) and age for men and women

The association between effort, reward and ERI and work schedule and working hours

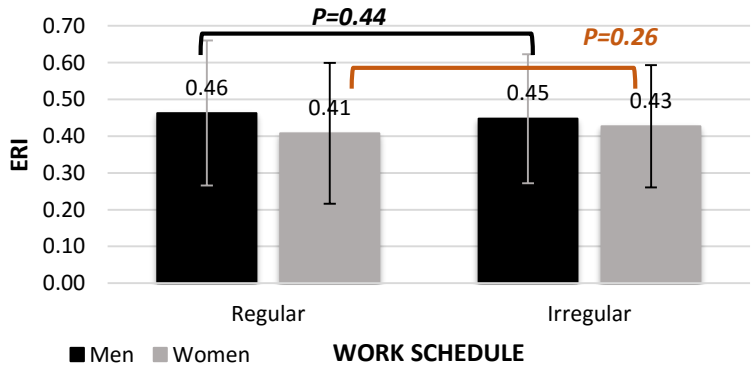
There was a positive association between reward and regular work schedule in women. No other associations between ERI components and work schedule were found for either men or women (*Figure 9*). Working hours had negative correlation with ERI in both genders and had positive correlation with effort and reward in women (*Table 50*).



(a)



(b)



(c)

Figure 9 Association between effort (a), reward (b) and ERI (c) and work schedule for men and women

The association between effort, reward and ERI and personality

Agreeableness was positively correlated with effort and reward, but was negatively correlated with the ERI in both genders. Extraversion was positively correlated with reward and ERI in women. Neuroticism was positively correlated with effort and reward in men, and was negatively correlated with ERI in both genders. Openness was positively correlated with effort and reward in men. There was no correlation between conscientiousness and effort or reward scales (see *Table 50*).

The association between effort, reward and ERI and number of life events

The number of life events was negatively correlated with ERI in men, but there was no correlation in effort and reward scale. For women, the number of life events was positively correlated with effort and reward, while it was negatively correlated with ERI.

Table 50 Correlation between ERI components and individual factors (personality, number of life events and working hours

	Effort		Reward		ERI	
Factors	*r*	*P*	*r*	*P*	*r*	*P*
Men						
Agreeableness	0.16	<0.001	0.14	0.001	-0.16	<0.001
Extraversion	0.05	0.25	0.07	0.13	-0.03	0.49
Neuroticism	0.14	0.001	0.13	0.003	-0.14	0.001
Openness	0.10	0.02	0.11	0.01	-0.04	0.37
Conscientiousness	0.04	0.40	0.03	0.44	0.01	0.83
Number of life events	0.07	0.06	0.04	0.32	-0.15	<0.001
Working hours	0.32	<0.001	-0.08	0.04	0.30	<0.001
Women						
Agreeableness	0.10	0.01	0.07	0.04	-0.10	0.01
Extraversion	0.05	0.17	0.08	0.02	0.09	0.01
Neuroticism	0.07	0.06	0.04	0.28	-0.09	0.01
Openness	0.04	0.22	0.04	0.23	-0.02	0.59
Conscientiousness	0.04	0.25	0.04	0.32	0.01	0.85
Number of life events	0.16	<0.001	0.12	0.001	-0.16	<0.001
Working hours	0.42	<0.001	-0.07	0.03	0.41	<0.001

Chapter 5 Summary, future directions and conclusions

5.1 Summary

A number of studies have shown that job stress is associated with health. Some authors suggest that it is directly associated with physical and mental health through biological pathways. However, there is also evidence that higher job stress is associated with poorer health indirectly via health risk behaviours. There is interest in understanding what causes job stress because this might help to stop it from developing or identify ways to manage it. As such, there have been a few studies that have investigated the role of childhood factors in adult job stress in line with theories of life course epidemiology. Most of these studies were conducted in Europe and used the proxy measure of the ERI model or the D-C model of job stress, instead of the standard ERI measurement. Studies of the factors in childhood that predict adult job stress have mostly looked at SEP factors. Therefore, the first aim of this thesis was to examine the association between childhood school- and health- related factors and SEP and adult job stress. Another area of interest in relation to job stress is its association with health risk behaviours because this may help us to understand whether its links with disease are direct or indirect. The existing studies of this association have tended to only look at a single risk factor and have not controlled for some possible confounding factors. Therefore, the second aim of this thesis was to examine the association between job stress and health risk behaviours, including their co-occurrence.

5.1.1 The association between childhood factors and adult job stress

The association between childhood factors and adult job stress (measured with the ERI scale) was shown in Chapter 3. This is the first longitudinal study on pre-employment risk factors from childhood for ERI in an Australian population. Previous studies of this association were extended by examining a comprehensive range of childhood factors as predictors of job stress

in adulthood in this thesis. The results revealed that lower adulthood ERI, indicating less job stress, was predicted by several school-related factors in men. For example, better learner self-concept and academic attainment. Childhood adverse health was associated with higher adulthood ERI, including being overweight and increasing negative affect in women. Adulthood SEP had no effect on these associations for men, but explained some of the effect in women. Childhood SEP had inconsistent associations with adult ERI. For example, higher area-level socioeconomic status in men but lower paternal occupation status in women predicted lower adulthood ERI.

5.1.2 The association between job stress and health risk behaviours

The association between job stress and health risk behaviours was shown in Chapter 4. This thesis adds to prior research by examining the standard ERI model in relation to the co-occurrence of health risk behaviours and detailed analyses of dietary behaviours. The results revealed that men with higher ERI, indicating higher job stress, were less likely to have 7 or more healthy behaviours. This group also did less leisure time physical activity per week, spent more time sitting during the weekend and had higher consumption of "extra" foods per day. Among women, greater job stress was associated with more walking (measured by pedometer steps per day), less transport related physical activity, a greater probability of being current smoker and consuming take away food two or more times per week.

5.2 Limitations

The findings presented in this thesis should be considered in conjunction with the limitations of these studies. While some were discussed within the respective results chapters, I provide more discussion of the key points in this section.

One potential limitation is loss to follow-up. Given that the CDAH study is a cohort and that data for present study was collected at 3 time-periods until 25-year follow-up (1985, 2004-05, 2009-11), loss to follow-up is inevitable. A comparison of participants and non-participants in childhood factors and a comparison participants and the general working population in Australia in similar age group was done to identify the extent to which these findings can be generalised to the rest of the Australian working population. Additionally, the remaining sample in CDAH-2 were compared the general population in Australia in a similar age group.

The comparison of the participants with complete childhood school-, health- and SEP related factors as well as adult ERI to those without these data in childhood characteristics was shown in Chapter 3. Despite the loss-to-follow-up in adulthood, those participants in the analyses of this thesis are similar to the original study cohort in terms of childhood school related factors and SEP factors, but participants are healthier than non-participants in terms of childhood health related factors. Both comparisons of the remaining sample in the CDAH-2 and the general population (Table *25*) and of the participants and the general working population [122] of a similar age in Australia in health risk behaviours were presented in Chapter 4. The participants in the analyses of this thesis and general working population in Australia [122] were similar in terms of several health risk behaviours. The proportion that reported favourable self-rated health were similar in the remaining sample in the CDAH-2 and general population in Australia (remaining sample 92% vs. general population 91%), however, the remaining sample in the CDAH-2 were healthier than the general population in Australia in terms of health risk behaviours. Furthermore, participants at follow-up were more often to have a higher education level and higher occupation status than people at the similar age in the general working population (see Chapter 3). Previous studies indicated that those workers with lower education level and lower occupation status were more likely to have higher levels of job stress [50, 51]. Therefore, participants in the analyses of this thesis mostly were at lower risk of job

stress than people at the same age in the general working population. Although the healthy status, indicated as health risk behaviours, of participants at follow-up were similar to the general working population, the remaining sample in the CDAH-2 had on average less probability of health risk behaviours than the general population. Thus, the findings of this thesis may not be widely generalisable to other demographic groups across Australia or elsewhere. These differences are more likely to lead to an underestimate of the true associations given that those not included tended to be those with lower socioeconomic status and worse health behaviours.

Another potential limitation is the restricted distribution of the ERI in the CDAH study. In the CDAH study, among those participants who completed ERI items there were only 1.6% participants who had total ERI ratio higher than 1, which is the cut-point for the ERI ratio (>1 indicates higher job stress) [8]. Due to most workers who experienced work-related mental stress not applying for workers' compensation, the exact prevalence of mental stress in the Australian workforce could not be statistically determined. Compared to European studies, participants in the CDAH study had lower ERI than those European cohorts with regard to the mean [SD] of effort and reward scales [8]. For example, in the WOLF-Norrland cohort conducted in Northern region of Sweden, the mean [SD] effort was 13.31 [4.87] in men and 12.31[4.97] in women and the mean [SD] reward was 46.40 [7.7] in men and 45.19[7.1] in women. For the CDAH study, the mean [SD] effort was 11.95[3.55] in men and 10.88[3.60] in women and mean [SD] reward was 49.26 [5.84] in men and 49.83 [5.40] in women [8]. Given that in the ERI model refers to the high imbalance, namely high job stress, caused by the high effort and low reward. Participants in the CDAH study were more likely to have favourable working conditions, namely low effort and high reward. The lower ERI in the CDAH study might be because of the age of the participants. The participants in the CDAH study are relatively young (31 to 41 years), which is lower than the peak age at which Australian workers

tend to report job stress (45 to 49 years) [4]. Also compared to the European cohorts we mentioned before, participants (more than 80%) in their cohorts were mostly older than 45 years [8]. The associations of childhood factors and ERI in adults and of ERI and health risk behaviours might be weakened by this limitation.

The analyses of job stress and risk behaviours were cross-sectional. It is therefore impossible to draw any conclusions about causality. As introduced at the beginning of this thesis, the IPD-Work Consortium did both cross-sectional and longitudinal studies on the association between job stress and health risk behaviours but the results were inconsistent for both methods. Excepting the negative association between job stress and physical activity, the association between job stress and other health risk behaviours, such as smoking and heavy drinking were not clear in the longitudinal data [34, 36, 37].

In this thesis, except for the pedometer steps per day and BMI, nearly all the variables were assessed by self-reported measures that may contribute to inaccuracies in the assessment of health risk behaviours, however, all measures used have been validated before [61, 78, 88, 148, 149]. Furthermore, the lack of events such as cardiovascular diseases or diabetes or biomedical risk factors that might contribute to chronic diseases (e.g. glucose, blood pressure, total high-density lipoprotein) could be considered as a limitation. If we had these we could give more information for the direct association between job stress and cardio-metabolic diseases in the CDAH study, though this association has been shown in other studies [13]. Future follow-ups of this cohort with physical measures will allow these associations to be confirmed.

As a study of the risk factors for cardiovascular disease, the CDAH study only collected data on a limited range of information about people's jobs and workplaces. Therefore, there is a tendency in this thesis to focus on individual-level risk factors for job stress. This is not to suggest that workplace level factors are not important, as they are clearly linked to the

development of job stress and its negative consequences [150, 151], but they were not captured in this study.

The analyses in this thesis made many comparisons between potential exposures and outcomes. There is therefore a risk that some associations were spurious and only occurred by 'chance'. A statistical approach to dealing with multiple comparisons was not taken with these analyses, in line with the discussion of Rothman on this issue[152]. The comparisons made in the analyses in this thesis were based on specific research questions informed by existing literature. The interpretation of whether associations were 'significant' were largely based on the magnitude of the effect and the plausibility of associations based on existing findings, as well as support from other relevant analyses conducted within this thesis.

5.3 Strengths

The study also has several strengths. The CDAH study is one of the few cohort studies to use the standard ERI measure, which includes 17 items (6 items effort and 11 items for reward). This is particularly novel in the Australian setting [8]. The IPD-Work Consortium, which is one of the largest research to advance research on the association between work related psychosocial risk factors including job strain (measure by the D-C model), ERI and long working hours and health, recently included an Australia cohort study,- the Household Income and Labour Dynamics in Australia (HILDA) Survey [153]. The HILDA survey is an Australia-wide survey comprising around 14,000 people aged 15 and aims to advance the research on income, labour market and family dynamics [154]. In their study, the job stress defined by the job strain and measure by the D-C model, not measured by the ERI model [155].

A great strength of the CDAH study is that the rich data source allowed us to control for a wide range of confounders, such as age, SEP, working hours, working schedule, but also life events and personality, which were not measured in previous studies [43]. Furthermore, the ability to

examine a range of covariates from childhood to adulthood is particularly unique. The association between SEP factors and ERI were presented in the Chapter 3 appendix, and the association between other covariates and ERI is presented in the Chapter 4 appendix.

This is the first study to examine the standard ERI model (17 items) in relation to the co-occurrence of personal health risk behaviours and considering dietary habits that were lacking before. To improve the understanding of the association between job stress and health risk behaviours and to make the findings easier to apply in workplace health promotions, the 10 items Healthy Life Score (includes diet habit items) was used in this study.

5.4 Implications

This study provides new evidence of the potential role of early life or pre-employment factors in the development of job stress. Previous studies on risk in job stress were mostly cross-sectional studies and mainly focused on both intrinsic work content and extrinsic work context (e.g. contract types of employment, shift work, occupation status and work-family conflict) [48, 49]. In this thesis, personal characteristics originating from childhood also appeared to play a role in the development of adult job stress. A positive school experience and better health status in early life appears to play a role in the reporting of job stress in the future. Therefore, experience at school is not only important for educational and occupational achievement but also important for psychosocial, mental and physical health across the life course. There has been some concern amongst those involved in trying to decrease job stress that employers believe job stress is caused only be individual-level factors [55]. The results show that individual-level factors are important. There was not detailed data on people's workplaces so analyses could not show how important these childhood risk factors were compared to all possible risk factors including those within the workplace.

In the present study, despite the fact that the cross-sectional nature of the analyses gave limited ability to infer the causality, job stress was associated with poor diet quality, more consumption of extra foods, doing less leisure time physical activity and more sitting time during weekend, as well as these risk behaviours co-occurring. Given the inability to identify the causal relationship between job stress and health risk behaviours, there is the possibility of reverse causation. Decreasing job stress might be beneficial for improving healthy lifestyle among workers, in turn, improving healthy lifestyles might also be beneficial for lowering job stress. Because both job stress and health risk behaviours are the risk factors for cardio-metabolic diseases, it is possible that workplace health promotion focused on decreasing job stress or improving health risk behaviours will be beneficial to health.

Reducing job stress might be beneficial for both the individual (e.g. improving their physical and mental health) and organisations (e.g. decreasing in absenteeism and benefits for economic) [151]. It is therefore possible that workplace health promotion might benefit from a reduction of job stress. A previous review by LaMontagne *et al.* based on 94 job stress intervention studies suggested that an effective job stress intervention should not only focus on individual level (e.g. improving coping ability of job stress) or organisation level (e.g. improvement of work environment), but also should focus on their combination [151].

In this thesis, job stress is conceptualised as the imbalance between high effort and low reward. Thus, decreasing employees' effort or increasing their reward could be a way to reduce job stress. Currently job stress interventions are mostly focused on work content (e.g., intensely work, time pressure, work repetitive *et al.*), but less related to other aspects of work (e.g. support by colleagues or supervisor, respect from others or job promotion prospects, salary). The reward scale of the ERI model focuses on the factors related to monetary aspects and getting support and respect from others [8]. Support from others, including supervisors and

colleagues, can buffer the relationship between stressors and job stress and mitigate stress responses [156]. Furthermore, those people providing help to others also might reduce mortality by buffering the association between job stress and mortality [157]. Thus, a way of reducing job stress in organisations level could be to focus on organisational cohesion, for example, ensure the responsibility of each worker, promote diversity of culture values, encourage supervisor or colleagues to assist others and promote exchanges and cooperation between workers. At a more basic level, a greater understanding among employees and employers about what job stress is could help with reducing the stigma around jobs stress and therefore improve its detection, prevention and management.

Additionally, given that the negative association between ERI and healthy lifestyle, the workplace health promotion program addressing lifestyle also might be beneficial for decreasing job stress. As discussed in Chapter 4, a healthy lifestyle, such as sustained leisure time physical activity might be beneficial for workers' ability to cope with job stress [35]. For improving health in the workplace, it is important to consider the differences in types of occupation groups. For example, levels, patterns and types of physical activity might differ between manual and non-manual employees. Thus, for non-manual or 'white collar' employees, efforts to increase leisure time physical activity, such as increasing opportunities for outdoor exercise during working hours might be important. For blue collar, reducing their working hours or making them more flexible might be beneficial to decrease their physical load in work, which might be beneficial for decreasing sitting time during the weekend. Additionally, organisations could provide the infrastructure services for improving physical health in the workplace. The New South Wales Government's 'Get Healthy at Work' program provide some suggestions to employers, such as encouraging employees to use stairs or active transport options (e.g. using public transport, parking the car further away from work), promoting local, state and national physical activity events [158].

Furthermore, the results suggested an association between 'comfort food' and job stress, which if causal, might be an attempt to self-medicate to relieve job stress. Regardless of the mechanism, workplaces can play a role in promoting health eating among employees. Recommended activities include encouraging employees to take meal breaks, supplying healthy food and drinks for catered meetings, functions and events, providing free water for drinking, providing healthy eating information in tea rooms and kitchens and providing the opportunities to increase knowledge and skills for healthy eating [159].

There was an association between job stress and smoking in women. Many people report smoking to reduce stress even though it might actually cause increases in stress [109, 160]. Workplaces are a good place to focus on smoking cessation interventions. This is because many cannot allow smoking inside or around the workplace, which allows for a teachable moment for employees around their smoking. There are a variety of programs available to workplaces that want to become 'smoke free' and help their employees to quit, such as smoking cessation programs for employees and increasing smoke free areas [161, 162].

5.5 Future directions

In this thesis, I tested the association of childhood factors and job stress and the association of job stress and health risk behaviours separately. Given that one of the CDAH study aims was to test whether childhood factors might contribute to later life health, future study based on the CDAH data could test whether job stress is the mediator of the association between childhood factors and adult health risk behaviours, even the cardio-metabolic diseases.

For the limitation of the cross-sectional nature of these analyses, there is a need for a longitudinal study to test the causal relationship between job stress and co-occurring health risk behaviours. I also know that job stress might contribute to chronic diseases, such as cardio-metabolic diseases, but I could not test this hypothesis in this thesis. Future studies of the

CDAH cohort could fill this gap and consider the childhood factors (e.g. learner self-concept, negative affect) as confounders of the association between job stress and health outcomes.

This thesis firstly used a 10 items Healthy Lifestyle Score, which is easy to calculate, as a measure of co-occurrence health risk behaviours. Future study in other cohorts could consider using this validated score to investigate the association between job stress and lifestyles, as well as considering it as an outcome in workplace health promotion programs. This score is good because it aligns with healthy living guidelines from health organisations and translates easily into targets for health behaviour change in individuals.

5.6 Conclusions

In this first detailed analysis of ERI in an Australian population, the association between school related factors, SEP and health related factors in childhood and ERI in adulthood was examined. A range of pre-employment factors not only SEP, but also school and health related factors predicted adult ERI. They may therefore explain some of the association between job stress and health among adults. Future studies of job stress and health should consider the effect of pre-employment factors including those from early in life. Analyses also explored the association between ERI and health risk behaviours. The associations between ERI and co-occurrence or separate health risk behaviours were present even after accounting for novel confounding factors. These findings provide further evidence of the close links between work and health, even in young people. Workplace health promotion may benefit both job stress and health risk behaviours among younger adults.

Chapter 6 References

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Questionnaire SF-12v2 Health Survey c. 1992, 2003 by Health Assessment Lab Chapter 7 pp.169-170
Questionnaire Chapter 7 pp.175-176
Questionnaire NEO Five Factor Inventory, by Paul Costa and Robert McCrae, c. 1978, 1985, 1989 by PAR, Inc Chapter 7 pp.178-179
Questionnaire SF-12v2 Health Survey c. 1992, 2003 by Health Assessment Lab Chapter 7 pp.186-187
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